IEEE-488 / IEC-625 BUS Interface PM3325/10 for Digital Storage Oscilloscopes PM3310, PM3311 and PM3315

Operating Manual

9499 440 26811
850211

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Industrial & Electro-acoustic Systems Division

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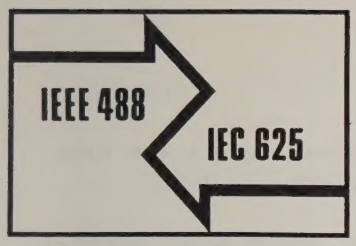

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IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

NOTE: The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

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1. INTRODUCTION

This interface is a general purpose bus line interface according to the IEEE-488/IEC-625 document by which the oscilloscope can be adapted to make communication possible with other IEEE-/IEC-bus compatible measuring instruments. This under the control of an IEEE-/IEC-bus controller.

For more detailed information about the bus system refer to the PHILIPS INSTRUMENTATION SYSTEMS "REFERENCE MANUAL" 9499 997 00411.

For more detailed information about the functioning of the hardware of the interface refer to the SERVICE MANUAL of the oscilloscope.

2. SPECIFICATION

2.1. INTERFACE FUNCTION REPERTOIRE

Interface function	Identification code	Description
Source handshake	SH1	Complete capability
Acceptor handshake	AH1	Complete capability
Talker function	T6	- Basic talker - Serial poll - Talk only - Unaddress if MLA
Listener function	L3	- Basic listener - Listen only - Unaddress if MTA
Service request	SR1	Complete capability
Remote local	RL2	No local lock out
Device clear	DC1	Complete capability
Device trigger	DT1	Complete capability

2.2. BUS DRIVER SPECIFICATIONS

Type of output E1 : Open collector output

2.3. TIMING SPECIFICATIONS

Timing controller --> oscilloscope

	Transfer of data bytes (ATN false)	Transfer of interface messages (ATN true)
Tac :	first byte $\leq$ 21 ms next bytes 6 ms approx.	: $\leq$ 4 /us + handshake time of the controller
Trd :	6 ms approx.	: $\leq$ 4 /us + handshake time of the controller
Tlst:	controller depending	: controller depending.
Tsc :	controller depending	: controller depending.

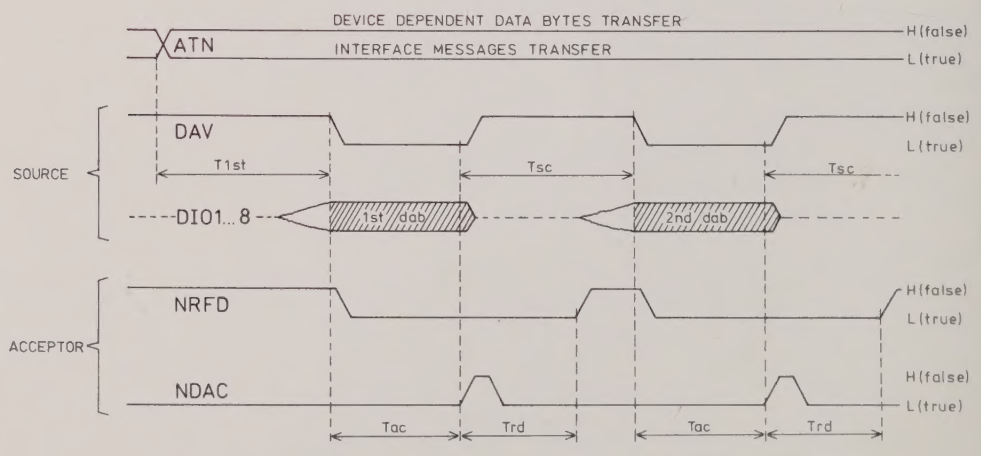
Note: the 6 ms for Tac and Trd is for controllers capable of sending data bytes with a delay worst case. For slow controllers the acceptance time is at least 21 ms/byte.

Timing oscilloscope --> controller

Tac : controller depending
Trd : controller depending
Tlst: < 6 ms
Tsc : 1 ms approx.

The response time with serial poll until output of status byte : 10 /us maximum

Tac = Time needed to accept the information byte.
Trd = Time needed until acceptor can receive a new information byte.
Tlst = Time needed for the first byte to get available on the bus.
Tsc = Time needed for the next byte to get available on the bus.



NOTES: - This timing diagram is valid for single source and single acceptor.
See also chapter 3.2.6. of the instrumentation systems manual 9499 997 00411.
- Trd starts at the moment that the acceptor sets NDAC false.

MAT 1466A

FIG. 2.1. Handshake timing.

2.4. CODE SPECIFICATIONS

Used code	: ISO - 7 bit code (ISO 646)
8 DIO lines	: Logic levels: TTL L = 1 (0 V < U < 0,8 V) H = 0 (2 V < U < 5 V)

2.5. SEPARATORS

Separators	: Input "unit separator" and "record separator" (controller --> oscilloscope) can be any character except: a-z, A-Z, 0-9, ?, +, -, %, SP and ESC . Output "unit separator" and "record separator" (oscilloscope --> controller) can be defined by the controller. Default value "unit separator" is COMMA (2C Hex.). Default value "record separator" is LF (ØA Hex.).

2.6. ADDRESS SETTING

Device address	: By means of 5 switches the bits of the device address are set.

2.7. MECHANICAL CONNECTOR SPECIFICATION

Type of connector	: 25 pole male connector, contact assignment according to IEC-625

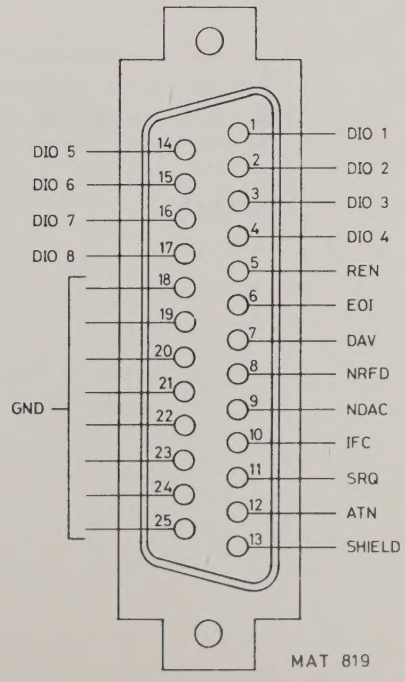


FIG. 2.2. IEC-625-bus connector.

3. PROGRAMMING INFORMATION

3.1. ADDRESS SETTING

First the correct oscilloscope (device) address has to be set.
This device-address is selectable by 5 DIP-switches 1-2-3-4-5 which are located at the IEC interface unit inside the instrument.
1 is the least significant bit, and 5 is the most significant bit.
Address selection information can be found in the supplement of the Operating Manual of the relevant instrument, and shall only be carried out by a qualified person who is aware of the danger involved.

"LISTEN ONLY" can be selected with switch LISTEN ONLY.
"TALK ONLY" can be selected with switch TALK ONLY.
Both switches have normally to be set to "0". For use of these switches see the chapter about the MEMORY DUMP function.

All addresses except 31 (=11111 binary), which is used for UNT and UNL, and except the controller address and the addresses of other devices are allowed.
At delivery the instrument is set to the device address 8 (=01000 binary).

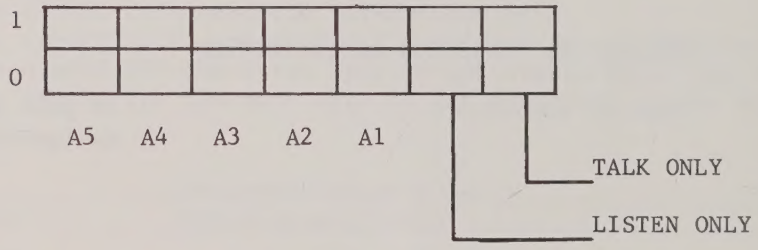


FIG. 3.1. Location of address selection switches.

EXAMPLE:

0	1	0	0	0	Device address 8
0	1	0	0	1	Device address 9
A5	A4	A3	A2	A1	Switch number

3.2. DESCRIPTION OF ACTIONS

The interface is capable to carry out the following actions:

SYSTEM FUNCTIONS:

- Program a "unit separator" character (USP).
- Program a "record separator" character (SPR).
- Program a wait time (delay time after every byte).
- Call for identity.

SUPER FUNCTIONS:

Front handling (FRO Ø).

- Transfer of frontpanel settings from oscilloscope to controller.
- Transfer of frontpanel settings from controller to oscilloscope.

Register handling (REG Ø, 1, 2 or 3)

- Transfer of register contents from oscilloscope to controller.
- Transfer of register contents from controller to oscilloscope.

SERVICE REQUEST:

- The oscilloscope can ask for service and will respond its status word when the controller executes a serial poll.

MULTI-LINE MESSAGES:

- Do a GROUP EXECUTE TRIGGER.
- Do a GO TO LOCAL.
- Do a SELECTIVE DEVICE CLEAR.
- Do a DEVICE CLEAR.
- Do a SERIAL POLL.

> In all examples the oscilloscope is assumed to be set to device address 8.

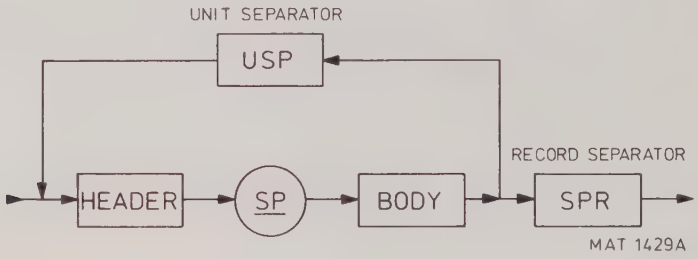
3.3. RECORD FORMAT

A RECORD is a sequence of so-called UNITS.
Each UNIT is separated from the next one by a UNIT SEPARATOR (USP).

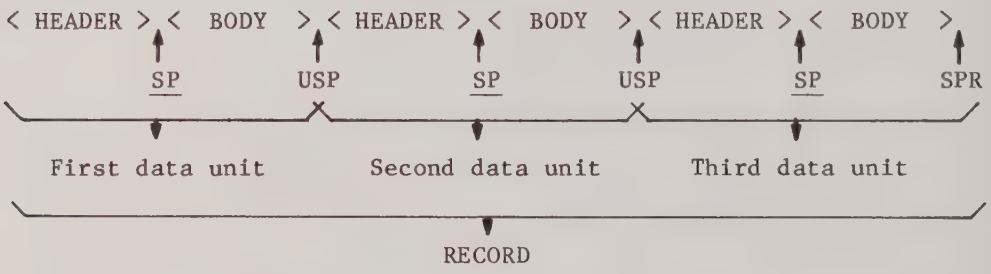
A UNIT to be transferred by the bus system consists always of two parts: a HEADER and a BODY.

HEADER and BODY are always separated by a SPACE (SP).

The last UNIT in a RECORD is terminated by a RECORD SEPARATOR (SPR), to indicate that no more data is following.



So:



When programming, a HEADER defines which function has to be programmed. A BODY defines a new state in which a function, which is defined by the HEADER, will be set.

3.3.1. Basic oscilloscope programming

The oscilloscope can be in two states:

- LOCAL state : Operator can control the device manually.
  (REMOTE led off).
- REMOTE state : Only devices on the bus can control the device.
  (REMOTE led on).

The REMOTE state is divided again in two different states:

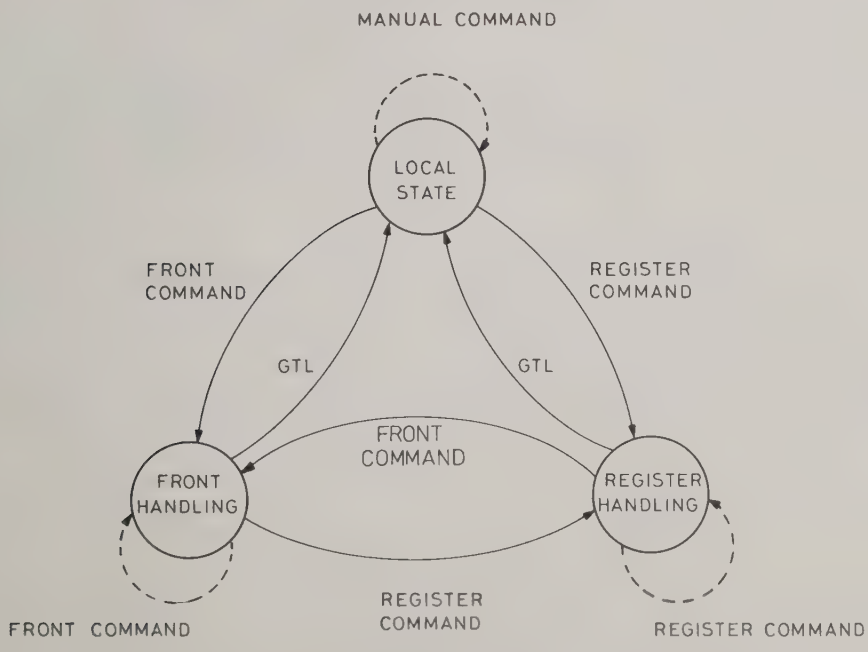
- FRONT handling state : Used for transfer of frontpanel settings.

  Controller --> device.
  or
  Device --> controller.

- REGISTER handling state : Used for transfer of register data and settings.

  Controller --> device
  or
  Device --> controller

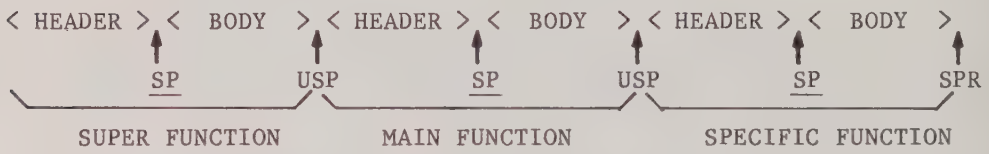
Note : Commands like GET (GROUP EXECUTE TRIGGER) and SDC (SELECTIVE DEVICE CLEAR will result in the FRONT handling state when coming from the LOCAL state.
Coming from the LOCAL state, every programming action which is not preceeded by a new state request, will result in the FRONT handling state.
The default setting is the "FRONT handling state".



In the FRONT handling state we can change the actual setting. In the REGISTER handling state we change the stored settings.
This means that changes in the frontpanel can result in changes in registers but not the other way around.
The default setting is FRO Ø.Basically the SUPER FUNCTIONS ´FRONT handling state´ and ´REGISTER handling state´ are the same.

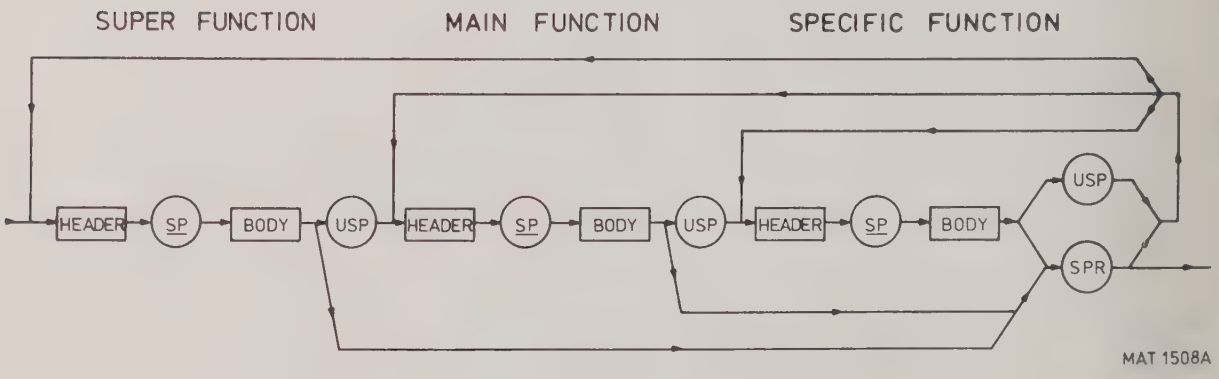
For each oscilloscope function, which has to be programmed, first such a SUPER FUNCTION must be selected, then a so-called MAIN FUNCTION and then one (or more) SPECIFIC FUNCTION(S).

So:



Example:

In this way the front panel is changed: The setting of the horizontal Main Time Base is now 50 ms/div



3.4. FUNCTIONS

3.4.1. System functions

The following four SYSTEM FUNCTIONS can be programmed:

- Program a UNIT SEPARATOR (USP).
- Program a RECORD SEPARATOR (SPR).
- Program a WAIT TIME (WTD).
- Call for IDENTITY (IDT).

3.4.1.1. Program a UNIT SEPARATOR

The UNIT SEPARATOR is the separator between two units (HEADER/BODY combinations).
The operator can program the UNIT SEPARATOR to which the oscilloscope will listen.
The default value is the ´,´ (comma; 2C Hex.).

The controller therefore must send:

The ISO-character is the UNIT SEPARATOR character itself (see specification) which can be filled in by the operator/controller.
From the moment that the oscilloscope has interpreted this command sequence, it will only accept the defined character as a UNIT SEPARATOR between two HEADER/BODY combinations.
The oscilloscope will then also send this character as SEPARATOR between two HEADER/BODY combinations.
This command is very usefull when a controller does not know the COMMA as a unit separator: with this instruction it is possible to program the oscilloscope to listen to the UNIT SEPARATOR the controller does know and to send the UNIT SEPARATOR the controller does know.

3.4.1.2. Program a RECORD SEPARATOR

The RECORD SEPARATOR is the separator at the end of a record of a number of HEADER/BODY combinations.
The operator can program the RECORD SEPARATOR to which the oscilloscope will listen.
The default value is the LF (ØA Hex.).

The controller therefore must send:

The ISO-character is the RECORD SEPARATOR character itself (see specification) which can be filled in by the operator/controller.
From the moment that the oscilloscope has interpreted this command sequence, it will only accept the defined character as a RECORD SEPARATOR at the end of a unit or a number of HEADER/BODY combinations.
The oscilloscope will then also send this character at the end of a record or a number of HEADER/BODY combinations.

This command is very usefull when a controller does not know the LF as a RECORD SEPARATOR: with this instruction it can program the oscilloscope to listen to the RECORD SEPARATOR the controller does know and to send the RECORD SEPARATOR the controller does know.

3.4.1.3. Program WAIT TIME

For some controllers it is needed that the time between sending the unit separator and the moment that new data is available can be programmed at a predefined value.
The default value (after power up) is about 1.5 ms (max. speed).

This can be programmed by sending:
(XX = wait time is ms excluding the internal delay of 1.5 ms)

XX = Ø ---> own internal delay of about 1.5 ms

A wait time of about 13.5 ms inserted between two data units can be programmed by:

Only integers between Ø and 9999 are allowed.

The controller is able to ask the oscilloscope to send the current "wait time" by sending the message:

The oscilloscope then answers for example:

NOTE: The answered wait time has always to be increased with the internal delay of 1.5 msNOTE: After a DEVICE CLEAR or a SELECTIVE DEVICE CLEAR statement, the unit separator, the record separator and the wait time are at the default value. They have then to be programmed again!

3.4.1.4. Call for IDENTITY

The controller is able to ask the oscilloscope to send its PM number and the used software release.
This can be programmed by sending:

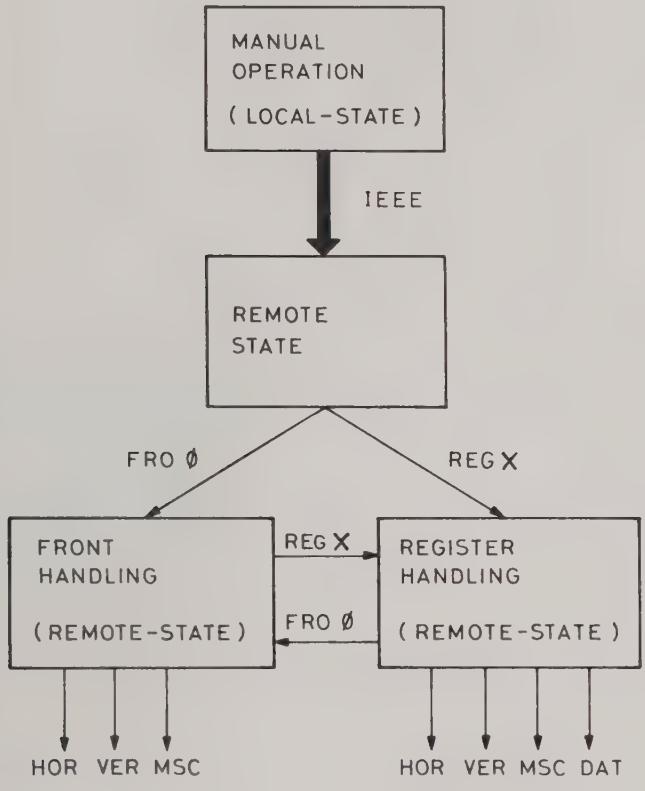
The oscilloscope then answers for example:

IDT SP PM3311.V.. USP PM3325-10.V.. SPR

(Software release ..)

3.4.2. Super functions

The system can be set in the LOCAL-state (manual operation) and in the REMOTE-state (FRONT handling state or REGISTER handling state).



SUPER FUNCTIONS which can be selected for this oscilloscope:

Header:	Body:	Function:
FRO	?	Request for front panel selection Answer may be: FRO ØØØØ or FRO OFF
FRO	ØØØØ	Select front panel (The leading zeros are not necessary)
FRO	OFF	Select register (same effect as REG ØØØØ)
REG	?	Request for actual register selection Answer may be: REG ØØØØ REG ØØØ1 REG ØØØ2 REG ØØØ3
REG	ØØØØ	Select register (The leading zeros are not necessary)
REG	OFF	Switches off the selected register

With the selection of one of the registers the following specific functions are initiated (see also register data transfer):

BGN 0
END 255 or 254 (DUAL or SINGLE channel resp.)
CNT 1
DAT ALL

Note: The functions in a register can be selected by the same method as used for the front-panel.

3.4.3. Main functions

The frontpanel functions of this oscilloscope can be split-up into four MAIN FUNCTIONS.

VER ---> VERtical channels

HOR ---> HORizontal channel

MSC ---> MiSCellaneous

DAT ---> DATa transfer

MAIN FUNCTIONS which can be selected for this oscilloscope:

Header:	Body:	Function:
VER	?	Request for vertical front panel settings Answer: see 3.5.1.
VER	A	Selection of vertical channel A
VER	B	Selection of vertical channel B
VER	ADD	Selection of the ADD mode of the vertical channels (A + B)
VER	SUB	Selection of the SUB mode of the vertical channels (A - B)
HOR	?	Request for horizontal front panel settings Answer: see 3.5.1.
HOR	MTB	Selection of the Main Time-Base
MSC	?	Request for miscellaneous front panel settings Answer: see 3.5.1.
MSC	AUX	Selection of miscellaneous functions
DAT	?	Request for the register data part from the oscilloscope(See also 3.5.3.)
DAT	ALL	Selection of the complete data register contents.
DAT	A	Selection of only the channel A register data points.
DAT	B	Selection of only the channel B register data points.

MAIN FUNCTION DAT can only be programmed after selection of SUPER FUNCTION REG ØØØØ or ØØØ1 or ØØØ2 or ØØØ3.

This DAT function offers the possibility to send or receive only a part of the signal to or from a controller for calculations or processing.

For each MAIN FUNCTION there is a TABLE with so-called SPECIFIC FUNCTIONS which can be selected after the selection of the MAIN FUNCTION.

VER ---> Table I see 3.4.4.
HOR ---> Table II see 3.4.4.
MSC ---> Table III see 3.4.4.
DAT ---> Table IV see 3.4.4.

3.4.4. Specific functions

TABLE I: (VER)

Header:	Body:	Function:
FCN	?	Request for function Answer may be : FCN ON or FCN OFF
FCN	ON	Selected channel --> active state
FCN	OFF	Selected channel --> inactive state
CPL	?	Request for coupling of the selected channel Answer may be : CPL DC, CPL AC, or CPL ZERO
CPL	DC	Selected channel is DC coupled
CPL	AC	Selected channel is AC coupled
CPL	ZERO	Input of selected channel is set to ZERO
PRO	?	Request for used probe Answer may be: PRO 1:1 or PRO 1:10 (Only valid when a probe with range indication is used)
CAL	?	Request for calibrated attenuator setting Answer may be be: CAL ON or CAL OFF
CAL	OFF	Set the attenuator in uncalibrated mode (Only valid in REG .... mode)
CAL	ON	Set the attenuator in the calibrated mode (Only valid in REG .... mode
INV	?	Request for inversion of channel B Answer may be: INV ON or INV OFF
INV	ON	Invert function active for channel B
INV	OFF	Invert function inactive for channel B

ATT	?	Request for actual attenuator setting Answer may be: 10E-03 10mV/div } not possible with 10:1 20E-03 20mV/div } probe with range ind. 50E-03 50mV/div } .1E+00 .1V/div .2E+00 .2V/div .5E+00 .5V/div 1E+00 1V/div 2E+00 2V/div 5E+00 5V/div 10E+00 10V/div 20E+00 20V/div 50E+00 50V/div .1E+03 100V/div } .2E+03 200V/div } only possible with 10:1 .5E+03 500V/div } probe with range ind.
ATT	XXESYY	Attenuator setting

EXAMPLE:

MANTISSA		E	SIGN	EXPONENT	
X	X	E	S	Y	Y
5	0	E	-	0	3

50×10^{-3}

50 mV/div.

TABLE II: (HOR)

Header:	Body:	Function:
MOD	?	Request for time base mode Answer may be: MOD REC, MOD SNG, MOD ROLL or MOD MLP
MOD	REC	Recurrent mode
MOD	SNG	Single shot mode reset. When the single shot mode is selected, the oscilloscope will start the measurement after a Group Execute Trigger has been given. Between the resetting and this GET command, a waiting time might be required, depending on the time base setting. NOTE: The first time that the single mode is programmed, the oscilloscope will measure immediately after the receipt of the first trigger pulse (so without the need of a GET command)
MOD	ROLL	Roll mode. The oscilloscope will start the measurement after the receipt of a Group Execute Trigger command. NOTE: When time base settings are programmed in the range where the ROLL mode is active, this ROLL mode will automaticaly switched on.
MOD	MLP	Multiple mode. When the multiple mode is selected, the oscilloscope will start the measurement after a Group Execute Trigger has been given.

TIM	?	Request for actual time base setting. Answer may be: 5E-09 5 ns/div 10E-09 10 ns/div 20E-09 20 ns/div Sampling mode 50E-09 50 ns/div .1E-06 0,1 µs/div PM3310 .2E-06 0,2 µs/div .5E-06 0,5 µs/div PM3311-PM3315 1E-06 1 µs/div 2E-06 2 µs/div 5E-06 5 µs/div 10E-06 10 µs/div 20E-06 20 µs/div 50E-06 50 µs/div .1E-03 100 µs/div .2E-03 0,2 ms/div Direct mode .5E-03 0,5 ms/div 1E-03 1 ms/div 2E-03 2 ms/div 5E-03 5 ms/div 10E-03 10 ms/div 20E-03 20 ms/div 50E-03 50 ms/div .1E+00 0,1 s/div .2E+00 0,2 s/div .5E+00 0,5 s/div 1E+00 1 s/div 2E+00 2 s/div 5E+00 5 s/div 10E+00 10 s/div 20E+00 20 s/div Roll mode 30E+00 30 s/div 60E+00 60 s/div .12E+03 120 s/div .36E+03 360 s/div .90E+03 900 s/div 1.8E+03 1800 s/div 3.6E+03 3600 s/div
TIM	XXESYY	Time-base setting Example: MANTISSA E SIGN EXPONENT X X E S Y Y 5 0 E - 0 3 50 x 10^{-3} 50 ms/div.

RDY	?	Request for ready state. Answer may be : RDY YES or RDY NO Answer is RDY YES in single shot -, roll -and multiple mode if the measurement is finished and in the recurrent mode if the oscilloscope is triggered.
TRD	?	Request for PRE TRIG state. Answer may be : any value between -0009 and 9999 in the direct mode and between 0000 and 0100 in the sampling mode or OFF In ROLL mode trigger delay setting is not possible, so the answer is always OFF.
TRD	SXXXX	Trigger delay in divisions. S is the sign and can only be programmed if a negative delay is required. With negative delay the leading zeros have to be left out. Examples: TRD -9 is correct TRD -09 is wrong TRD -009 is wrong TRD -0009 is wrong TRD 250 is correct TRD 0250 is correct TRD +250 is wrong TRD +0250 is wrong

(HOR) Supplement for PM3315 only:

Header:	Body:	Function:
TSO	?	Request for trigger source. Answer may be: TSO A, TSO B, TSO EXT or TSO LINE
TSO	A	Trigger signal derived from channel A
TSO	B	Trigger signal derived from channel B
TSO	EXT	Trigger signal derived from the external input. Selection between EXT and EXT :10 has to be choosen manualy.
TSO	LINE	Trigger signal derived from the line frequency
CPL	?	Request for trigger coupling Answer may be: CPL DC, CPL AC, CPL AUT or CPL TVF
CPL	DC	Triggering DC coupled
CPL	AC	Triggering AC coupled
CPL	AUT	Triggering in auto peak-peak mode for signals above 20Hz and free running in absence of trigger signals
CPL	TVF	Triggering to obtain television frame synchronisation
LEV*	?	Request for actual level position Answer may be: any value between 0000 and 0255
LEV*	XXXX	Level setting: XXXX may be any value between 0000 and 0255. The leading zeros are not necessary
TSL	?	Request for the trigger slope Answer may be: TSL POS or TSL NEG
TSL	POS	Triggering on the positive going slope of the trigger signal
TSL	NEG	Triggering on the negative going slope of the trigger signal

*Leveling depends on the coupling of the triggering. In AUTO mode the values between 0 and 256 are situated between the positive and negative peaks of the input signal.

In DC and AC mode the values between 0 and 256 are situated between + and - 3 divisions in the Yxl mode

TABLE III: (MSC)

Header:	Body:	Function:
DSP	?	Request for display function Answer may be: In FRO 0000 mode: DSP OFF or DSP ALL In REG 000X mode: DSP OFF or DSP ON
DSP	OFF	In FRO 0000 mode: The display of all registers is switched off except for the accu display which remains always on. In REG 000X mode: The display of the selected register is switched off. In the case that the selected register was the only one which was displayed the display remains on. When after this command the display of another register is switched on, this action will result in switching on the display of the last mentioned register and switching of the register which was displayed.
DSP	ALL	Only valid in FRO 0000 mode. The display of the accu and all three registers is switched on.
DSP	ON	Only valid in REG 000X mode. The display of the selected register is switched on. When there was already a register displayed which was switched off by programming DSP OFF, before the result of DSP ON will be: Switching on the selected register and switching off the displayed register. Example: Suggest that only register 0001 is displayed. When programming the following lines Action — Result 1) REG 1,MSC AUX,DSP OFF — display of REG 0001 remains on 2) REG 2,MSC AUX,DSP ON — display of REG 0002 is switched on and display of REG 0001 is switched off

CLR	?	Request for CLEAR state. Answer may be : CLR ON or CLR OFF
CLR	ON	Clear the accumulator until the function "CLR OFF" is programmed.
CLR	OFF	Stop clearing the digital memory
WRT	?	Request for WRITE state. Answer may be : WRT ON or WRT OFF
WRT	ON	The accumulator contents can be refreshed This is the same function as LCK OFF
WRT	OFF	The accumulator contents is locked The same function as LCK ON
LCK	?	Request for LOCK state. Answer may be : LCK ON or LCK OFF
LCK	ON	The accumulator is locked The same function as WRT OFF
LCK	OFF	The accumulator contents can be refreshed The same function as WRT ON
SAV	?	Request for SAVE function Answer may be : SAV 0000, SAV 0001, SAV 0002, SAV 0003 or a combination of these functions
SAV	XXXX,XXXX	Select the desired register(s) for the save action Example: SAV 0001,0002,0003 Result : The contents of the accumulator is stored continiously in the registers 0001,0002 and 0003 The leading zeros are not necessary.
SAV	OFF	Save function of all registers is switched off.
YVT	?	Request for X=t state. Answer may be : YVT ON or YVT OFF
YVT	ON	Display of vertical channel versus time axes Same function as YVX OFF
YVT	OFF	Display of vertical channel versus vertical channel (X=A/Y=B) Same function as YVX ON
YVX	?	Request for X=A/Y=B state. Answer may be : YVX ON or YVX OFF
YVX	ON	Display of vertical channel versus vertical channel (X=A/Y=B) Same function as YVT OFF
YVX	OFF	Display of vertical channel versus time axes Same function as YVT ON

YEX	?	Request for the YEXPAND mode Answer may be: YEX ON or YEX OFF
YEX	ON	Expanded Y-display
YEX	OFF	Normal Y-display
DOT	?	Request for dot join display Answer may be : DOT ON or DOT OFF
DOT	ON	Display of only dots
DOT	OFF	Display of dot join
PLT	?	Request for PLOT state Answer may be: PLT YES or PLT NO
PLT	YES	PLOT function active
PLT	NO	PLOT function inactive or interrupted

TABLE IV: (DAT) (See also 3.5.3.)

Header:	Body:	Function:
DAT	?	Request for the register data part from the oscilloscope which is selected by DAT ALL or DAT A or DAT B
BGN	?	Request for start address of data transfer. Answer may be : BGN 0000.... BGN 0255
BGN	XXXX	The start address of the transfer of data XXXX = integer 0000...0255 (decimal)
END	?	Request for end address of data transfer. Answer may be : END 0000.... END 0255
END	XXXX	The end address of the transfer of data XXXX = integer 0000....0255 (decimal)
CNT	?	Request for count factor. Answer may be : CNT 1 or CNT 2 or CNT 3 etc.
CNT	XXXX	This is the so-called resolution factor X = 0000: is not allowed. X = 0001: all points selected X = 0002: every second points selected Etc. The following data of the selected channel is meant: BGN, BGN + X, BGN + 2X, BGN + 3X etc.
DAT	A	Select channel A of actual register
DAT	B	Select channel B of actual register
DAT	ALL	Select both channels of the actual register
DAT	XXXX	Transfer data to the oscilloscope XXXX = 0000....0255 The leading zeros are not necessary

NOTE: BGN, END and CNT are with respect to DAT selection.

3.4.5. The use of the question mark "?".

- Only the controller is allowed to send a question mark as BODY to request the oscilloscope for information.
  Each message from the controller to the oscilloscope may contain only one question mark.
- The instrument answers after the reception of the record separator (SPR).
- When only a MAIN FUNCTION header is programmed by the controller with BODY "?", all the SPECIFIC FUNCTIONS of this MAIN FUNCTION will be generated.

3.5 TRANSFERS

3.5.1 FRONTPANEL transfer (Oscilloscope --> controller)

The controller asks the oscilloscope for the frontpanel settings by sending:

FRO Ø and then one of the following three MAIN functions.

1) VER ?
The oscilloscope then answers in the following sequence:

```
VER ADD
FCN ON or FCN OFF
VER SUB
FCN ON or FCN OFF
VER A
FCN ON or FCN OFF
CPL DC or CPL AC or CPL ZERO
PRO 1:1 or PRO 1:10
ATT XXSEYY
CAL ON or CAL OFF
VER B
FCN ON or FCN OFF
CPL DC or CPL AC or CPL ZERO
PRO 1:1 or PRO 10:1
INV ON or INV OFF
ATT XXESYY
CAL ON or CAL OFF
```

2) HOR ?
The oscilloscope then answers in the following sequence:

```
HOR MTB
MOD REC or MOD SNG or MOD MPL or MOD ROLL
TIM XXESYY
*TSO A or TSO B or TSO EXT
*CPL AUT or CPL DC or CPL AC or CPL TVF
*LEV XXXX
*TSL POS or TSL NEG
RDY YES or RDY NO
TRD SXXXX or TRD OFF
```

* For PM 3315 only

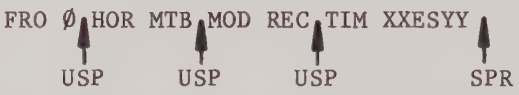
3) MSC ?
The oscilloscope then answers in the following sequence:

```
MSC AUX
DSP ALL or DSP OFF
CLR ON or CLR OFF
WRT ON or WRT OFF
SAV 000X or SAV OFF
YVT ON or YVT OFF
YVX ON or YVX OFF
YEX ON or YEX OFF
DOT ON or DOT OFF
PLT YES or PLT NO
```

3.5.2. FRONTPANEL transfer (Controller --> oscilloscope)

A new frontpanel setting can be programmed by the controller by sending SUPER function FRO Ø followed by a MAIN function and then one or more SPECIFIC functions.

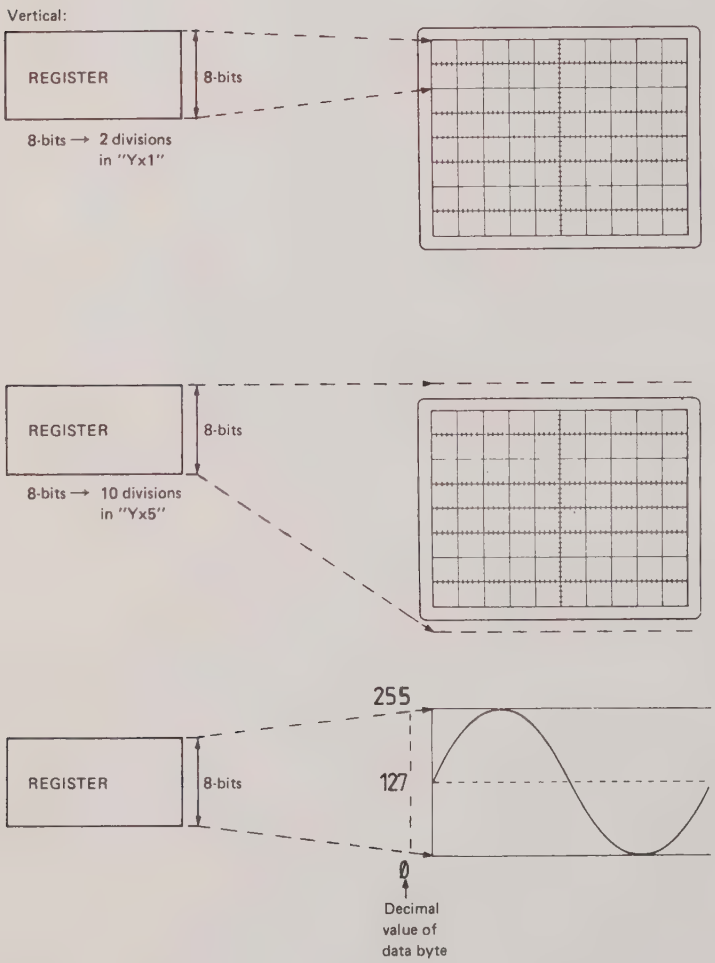
Example:

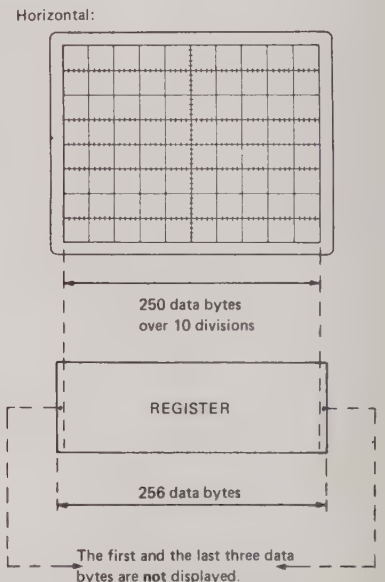


Note: The programming sequence for SPECIFIC functions is not dictated.

3.5.3. REGISTER data transfer

Register contents VS display:




Horizontal:
250 data bytes over 10 divisions
REGISTER
256 data bytes
The first and the last three data bytes are not displayed. However, the data which is stored in the register is correct. There is only one exception, namely in P2CCD-mode (TIME/DIV switch positions 0.2 ms/div. ... 0.5 µs/div.) the last byte will contain incorrect information.

TIME/DIV	FREQUENCY	MODE	TIME BETWEEN TWO SAMPLES
5 ns/div		S	0.2 ns
10 ns/div		S	0.4 ns
20 ns/div		S	0.8 ns
50 ns/div		S	2 ns
0.1 µs/div		S	4 ns
0.2 µs/div		S	8 ns
	TBF		
0.5 µs/div	50 MHz	P	20 ns
1 µs/div	25 MHz	P	40 ns
2 µs/div	12,5 MHz	P	80 ns
5 µs/div	5 MHz	P	200 ns
10 µs/div	2.5 MHz	P	400 ns
20 µs/div	1.25 MHz	P	800 ns
50 µs/div	0.5 MHz	P	2 µs
0.1 ms/div	0.25 MHz	P	4 µs
0.2 ms/div	125 kHz	P	8 µs
	TBS		
0.5 ms/div	50 kHz	D	20 µs
1 ms/div	25 kHz	D	40 µs
2 ms/div	12.5 kHz	D	80 µs
5 ms/div	5 kHz	D	200 µs
10 ms/div	2.5 kHz	D	400 µs
20 ms/div	1.25 kHz	D	800 µs
50 ms/div	500 Hz	D	2 ms
0.1 s/div	250 Hz	D	4 ms
0.2 s/div	125 Hz	D	8 ms
	TBS		
0.5 s/div	50 Hz	R	20 ms
1 s/div	25 Hz	R	40 ms
2 s/div	12.5 Hz	R	80 ms
5 s/div	5 Hz	R	200 ms
10 s/div	2.5 Hz	R	400 ms
20 s/div	1.25 Hz	R	800 ms
30 s/div	5/6 Hz	R	1.2 s
60 s/div	5/12 Hz	R	2.4 s
120 s/div	5/24 Hz	R	4.8 s
360 s/div	5/72 Hz	R	14.4 s
900 s/div	5/180 Hz	R	36 s
1800 s/div	5/360 Hz	R	72 s
3600 s/div	5/720 Hz	R	144 s

NOTE: Only in the P²CCD-mode and SAMPLING-mode the time between two samples as mentioned in the table is **not** *the real time.*

The real sampling time in these modes is much longer because of the principle of these modes.

In P²CCD-mode the time difference is caused by the time conversion principle and in SAMPLING-mode the time difference is caused by inactive triggers which is normal in a sampling system.

Explanation of data transfer method:

Super function is always REG 0000 or 0001 or 0002 or 0003

In the function DAT (header) the following bodies can be programmed:

DAT ALL
DAT A
DAT B

With DAT ALL selected the complete memory contents is transfered. In DUAL channel mode for example the channels A and B will be represented as follows: One value of: channel A, channel B, channel A, etc.

With DAT A or DAT B selected, only the memory contents of the selected channel is transfered.

Moreover the following has to be programmed:

- Selection of the start address (BGN XXXX).
  This is the first address of the data transfer given or asked by the controller.
  The default value is Ø.

- Selection of the end address (END XXXX).
  This is the last address of the data transfer given or asked by the controller.
  The default value is 255.

- Selection of the resolution (CNT XXXX).
  XXXX contains a number, giving the ratio between the number of transferred display data values and the total available number of display data values in the register. The default value is "1" which means that all the display data values between BGN and END are transfered, and the maximum value is 255.

NOTES:

- The HEADERs REG and DAT are always necessary.
- With DAT selected, BGN, END and CNT are optional.

3.5.3.1. REGISTER DATA transfer (Oscilloscope --> controller)

The controller asks the oscilloscope for the actual register settings by sending:

REG 000X and then one of the following four MAIN functions.

1) VER ?

The oscilloscope then answers in the following sequence:

```
VER ADD
FCN ON or FCN OFF
VER SUB
FCN ON or FCN OFF
VER A
FCN ON or FCN OFF
CPL DC or CPL AC or CPL ZERO
ATT XXESYY
CAL ON or CAL OFF
VER B
FCN ON or FCN OFF
CPL DC or CPL AC or CPL ZERO
INV ON or INV OFF
ATT XXESYY
CAL ON or CAL OFF
```

2) HOR ?

The oscilloscope then answers in the following sequence:

```
HOR MTB
MOD REC or MOD SNG or MOD MPL or MOD ROLL
TIM XXESYY
TRD XXXX or TRD OFF
```

3) MSC ?

The oscilloscope then answers in the following sequence:

```
MSC AUX
DSP ON or DSP OFF
INV ON or INV OFF
PLT YES or PLT NO
```

4) DAT ALL DAT ?

The oscilloscope answers with: DAT XXXX
(XXXX is a data-value from channel A or B depending on the setting of BGN)

DAT A DAT ?

The oscilloscope answers with: DAT XXXX
(XXXX is a data-value of channel A depending on the setting of BGN)

DAT B DAT ?

The oscilloscope answers with: DAT XXXX
(XXXX is a data-value of channel A depending on the setting of BGN)

In the transfer programm a "FOR NEXT" loop is required to transfer more than 1 data value!

In the following programm the data contents of register 1 is asked for channel A with settings: BGN 10, END 100, CNT 1 as an example:

```
 10 ! PROGRAMM NAME 3315-3
 20 ! EXAMPLE PROGRAM for data
    transfer:SCOPE-->CONTROLLER
 30 ! INITIALIZE
 40 CONTROL 7,16 ; 1,10
 50 ! Set oscilloscope ADDRESS
 60 P=708
 70 ! Program SEPERATORS
 80 OUTPUT P USING "K" ; "USP /"
 90 ! Program SETTINGS (example)
100 OUTPUT P USING "K" ; "WTD 20
    0"
110 OUTPUT P USING "K" ; "REG 1/
    VER A/FCN ON/BGN 10/END 100/
    CNT 1/DAT ?"
120 ! First information received
    via the bus is: DAT XXX
130 ENTER P ; S$
140 DISP S$
150 ! Rest of information must
    be transfered in a loop
160 FOR I=1 TO 90
170 ENTER P ; A$
180 DISP I;"=";A$;",";
190 NEXT I
200 DISP
210 END
```

The final value in the for next loop can be found easily by the next expression:

final value = BGN + (END - BGN)/(CNT * X) X=number of channels

3.5.3.2. REGISTER DATA transfer (Controller --> oscilloscope)

A new register setting can be programmed by the controller by sending:

REG 000X followed by a MAIN function and then one or more SPECIFIC functions to the oscilloscope.

Example:

NOTE: The programming sequence for SPECIFIC functions is not dictated.

Programming the register settings in REG Ø is only possible after the front panel selection LCK ON. Furthermore the programming is identical to the programming of the frontpanel. Also one or more of the functions DAT - BGN - END and CNT have to be programmed.

In the transfer programm a "FOR NEXT" loop is required to transfer more than 1 data value!

Data values for channel A are sent to register 1 of the oscilloscope in the following program with the settings: BGN 10, END 100, CNT 1 and writes a sloping line from the first 0.25 div upto the fourth div:

```
 10 ! PROGRAMM NAME 3315-2
 20 ! EXAMPLE PROGRAM for data
    transfer:CONTROLLER-->SCOPE
 30 ! INITIALIZE
 40 CONTROL 7,16 ; 1,10
 50 ! Set oscilloscope ADDRESS
 60 P=708
 70 ! Program SEPERATORS
 80 OUTPUT P USING "K" ; "USP /"
 90 ! Program SETTINGS (example)
100 OUTPUT P USING "K" ; "REG 1/
    VER A/FCN ON/BGN 10/END 100/
    CNT 1"
110 ! First information sent
    over the bus must be: DAT XX
    X
120 OUTPUT P USING "K" ; "DAT 12
    7"
130 ! Rest of information must
    be sent in a LOOP
140 FOR I=1 TO 90
150 X=127+I
160 OUTPUT P USING "K" ; X
170 NEXT I
180 END
```

The final value in the for next loop can be found easily by the next expression:

final value = BGN + (END - BGN)/(CNT * X) X=number of channels

NOTE: Measuring data is send in decimals from Ø up to 255 (The leading zero's are blanked and the data values are separated by separators).

3.6 SERVICE REQUEST (SRQ) + STATUS WORD

The oscilloscope is capable to send an active SRQ on the bus to indicate a special condition of the instrument. Also the RQS-bit of the device status word is set.

A request for service is given if:

1 - The oscilloscope indicates a fault (for example if an incorrect programming code has been received).
2 - The oscilloscope has finished the measurement for which it was triggered via a Group Execute Trigger command.
3 - The input buffer is full.

After the controller has indicated that the SRQ line is active, the controller can do a SERIAL POLL action to find out why the SRQ line is activated by the oscilloscope.
The controller can address the oscilloscope as "serial poll talker", after which the device status word is set on the Bus lines (DIO8...DIO1) by the oscilloscope.

The SRQ-message is automatically reset after acknowledge from the controller. Via SERIAL POLL (1. and 2.) or reading the data (3.). and 4.

3.6.1. Reading the device status word of the oscilloscope.

The status word can be read by programming a SERIAL POLL action.

- Send UNListen.
- Send SPE (Serial Poll Enable).
- Make the oscilloscope TALKER.
- Make controller LISTENER.
- Read STATUS-word.
- Send UNTalk.
- Send SPD (Serial Poll Disable).

3.6.2. The STATUS-word of the oscilloscope.

The device dependent bits in the status word specify the reasons for service request and / or reflect the status of the device functions.

The status word can have a few different values:

Ø : nothing of interest is happening.
1 : programming error.
4 : valid data is on the bus (used during transfer).
8 : input buffer full.
16 : the oscilloscope is busy with a programmed measurement.
32 : something is wrong : ABNORMAL.
64 : the oscilloscope has an active service request.

There can also be a combination of these basic values e.g. when the oscilloscope is ready with a measurement it activates the service request. The STATUS would be $\geq$ 64 now.
By waiting on a service request after a GROUP EXECUTE TRIGGER the controller can check when the oscilloscope is ready with that measurement.

The device STATUS-word (8 bits) from the oscilloscope is built up as follows:

128	64	32	16	8	4	2	1	
DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1	IEEE-Bus input/output lines.
EXT	RQS	AB	BS	EF3	EF2	EF1	EFØ	
X	X	X	X	0	0	0	0	normal / normal
				0	0	0	1	programming fault
				0	0	1	0	internal error
				0	0	1	1	
				0	1	0	0	data ready to be transferred
				0	1	0	1	
				1	0	0	0	input buffer full

: Extension bit:
This bit is not used and is always "Ø".

: Service request bit:
RQS = Ø:
No request for service is given.
RQS = 1:
A request for service has been given by the oscilloscope.

: Abnormal bit:
AB = Ø
No erroneous or alarm condition detected.
The status is specified in the bits EF3 - EFØ.
AB = 1
The oscilloscope is in an erroneous or alarm condition. The fault condition is specified in the bits EF3 - EFØ.

: Busy bit:
BS = Ø
The oscilloscope is not measuring (ready with programmed action).
BS = 1
The oscilloscope is measuring (busy with programmed action).

: Bits EF3 - EFØ Error code:

AB = Ø	AB = 1

3.7 MULTI LINE MESSAGES (WITH ATN TRUE).

3.7.1. GO TO LOCAL command

There are three ways to get the oscilloscope out of the remote situation and these are: hardware reset (power off, power on), and via an IEEE bus command GTL (Go To Local) or by activating the REN line. To get the oscilloscope out of its current remote situation send:

X0000001 (with ATN true)

After executing this command the oscilloscope is listening again to the knobs at the frontpanel.

3.7.2. GROUP EXECUTE TRIGGER command

It is possible for the controller to tell the oscilloscope when to start a measurement by using the IEEE bus GET (Group Execute Trigger) command. This is done by sending:

X0001000 (with ATN true)

Since there are four modes of measurement (recurrent, single, multiple and ROLL) there are four different interpretations possible for the oscilloscope:

Recurrent : no interpretation, measurements are continuous
Single : re-arm the single shot mode
Multiple : re-arm the multiple mode
Roll : starts the roll mode

For these modes there will be a service request after the measurement is ready and in the recurrent mode as soon as the oscilloscope is triggered. This service request will stay active until the status of the oscilloscope is loaded into the controller.
After this, the service request is resetted by the oscilloscope and can be enabled by a new GET (Group Execute Trigger) command.

3.7.3. SELECTIVE DEVICE CLEAR command

The oscilloscope is capable of receiving and executing an SDC (Selective Device Clear) command from the IEEE bus.
The controller sets the oscilloscope in the selective device clear state by sending:

Device listener address followed by:

X0000100 (with ATN true)

On receiving this command the oscilloscope will, execute the following:

- Clear the IEEE hardware interface and software work space.
- Place a new frontpanel situation that exists when all pushbuttons on the oscilloscope are released.

- Default settings:
```
VER ADD
FCN OFF
VER SUB
FCN OFF
VER A
FCN ON
CPL DC
PRO 1:1 or PRO 10:1
ATT .5E+00
CAL ON or CAL OFF
VER B
FCN OFF
CPL DC
PRO 1:1 or PRO 10:1
INV OFF
ATT .5E+00
CAL ON or CAL OFF
HOR MTB
MOD REC
TIM .5E-03
*TSO A
*CPL AUT
*LEV 0127
*TSL POS
RDY YES
TRD OFF
MSC AUX
DSP OFF
CLR OFF
WRT ON
SAV OFF
YVT ON
YVX OFF
YEX OFF
DOT OFF
PLT NO
```

*For PM 3315 only.
This predefined state is a state which is stored in the PROM of the oscilloscope.

3.7.4. DEVICE CLEAR command

The oscilloscope is capable of receiving and executing a DCL (Device CLear command) from the IEEE bus.
The controller sets the oscilloscope in the device clear state by sending:

X0010100 (with ATN true)

On receiving this command the oscilloscope will, execute the following:

* Clear the IEEE hardware interface and software work space.
* Place a new frontpanel situation that exists when all pushbuttons on the oscilloscope are released.
* The default settings are the same as under SELCTIVE DEVICE CLEAR

This predefined state is the state which is stored in the PROM of the oscilloscope.

3.8. ISO-7 BIT CODING TABLE

COLUMN →		0			1			2			3			4			5			6			7		
ROW ↓	b7 → b6 → b5 →	0	0	0	0	0	1	0	1	0	0	1	1	1	0	0	1	0	1	1	1	0	1	1	1
	b4 b3 b2 b1 ↓ ↓ ↓ ↓	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1	ISO-7 bit	dec equiv	ATN = 1
0	0 0 0 0	NUL	0		DLE	16		SP	32	0	0	48	16	@	64	0	P	80	16	`	96		p	112	
1	0 0 0 1	SOH	1	GTL	DC1	17	LLO	!	33	1	1	49	17	A	65	1	Q	81	17	a	97		q	113	
2	0 0 1 0	STX	2		DC2	18		"	34	2	2	50	18	B	66	2	R	82	18	b	98		r	114	
3	0 0 1 1	ETX	3		DC3	19		#	35	3	3	51	19	C	67	3	S	83	19	c	99		s	115	
4	0 1 0 0	EOT	4	SDC	DC4	20	DCL	$	36	4	4	52	20	D	68	4	T	84	20	d	100		t	116	
5	0 1 0 1	ENQ	5	PPC	NAK	21	PPU	%	37	5	5	53	21	E	69	5	U	85	21	e	101		u	117	
6	0 1 1 0	ACK	6		SYN	22		&	38	6	6	54	22	F	70	6	V	86	22	f	102		v	118	
7	0 1 1 1	BEL	7		ETB	23		'	39	7	7	55	23	G	71	7	W	87	23	g	103		w	119	
8	1 0 0 0	BS	8	GET	CAN	24	SPE	(	40	8	8	56	24	H	72	8	X	88	24	h	104		x	120	
9	1 0 0 1	HT	9	TCT	EM	25	SPD	)	41	9	9	57	25	I	73	9	Y	89	25	i	105		y	121	
10 A	1 0 1 0	LF	10		SUB	26		*	42	10	:	58	26	J	74	10	Z	90	26	j	106		z	122	
11 B	1 0 1 1	VT	11		ESC	27		+	43	11	;	59	27	K	75	11	[	91	27	k	107		{	123	
12 C	1 1 0 0	FF	12		FS	28		,	44	12	<	60	28	L	76	12	\	92	28	l	108		|	124	
13 D	1 1 0 1	CR	13		GS	29		–	45	13	=	61	29	M	77	13	]	93	29	m	109		}	125	
14 E	1 1 1 0	SO	14		RS	30		.	46	14	>	62	30	N	78	14	^	94	30	n	110		~	126	
15 F	1 1 1 1	SI	15		US	31		/	47	15	?	63	UNL	O	79	15	_	95	UNT	o	111		DEL	127	

ADDRESSSED COMMAND GROUP

UNIVERSAL COMMAND GROUP

LISTEN ADDRESS GROUP

TALK ADDRESS GROUP

SECONDARY ADDRESS GROUP

4. FUNCTIONAL TESTS

This chapter gives a functional test of the system combination: Oscilloscope - IEEE interface - IEEE bus controller.

The undermentioned functions can be checked:

- Device address settings on interface card (not by controller)
- Switching to REMOTE control
- GO TO LOCAL
- SELECTIVE DEVICE CLEAR
- Frontpanel transfer (oscilloscope -> controller)
- Frontpanel transfer (controller -> oscilloscope)
- Register data transfer (oscilloscope -> controller)
- Register data transfer (controller -> oscilloscope)
- GROUP EXECUTE TRIGGER
- SERIAL POLL and reading the data word

The programs are suitable for:

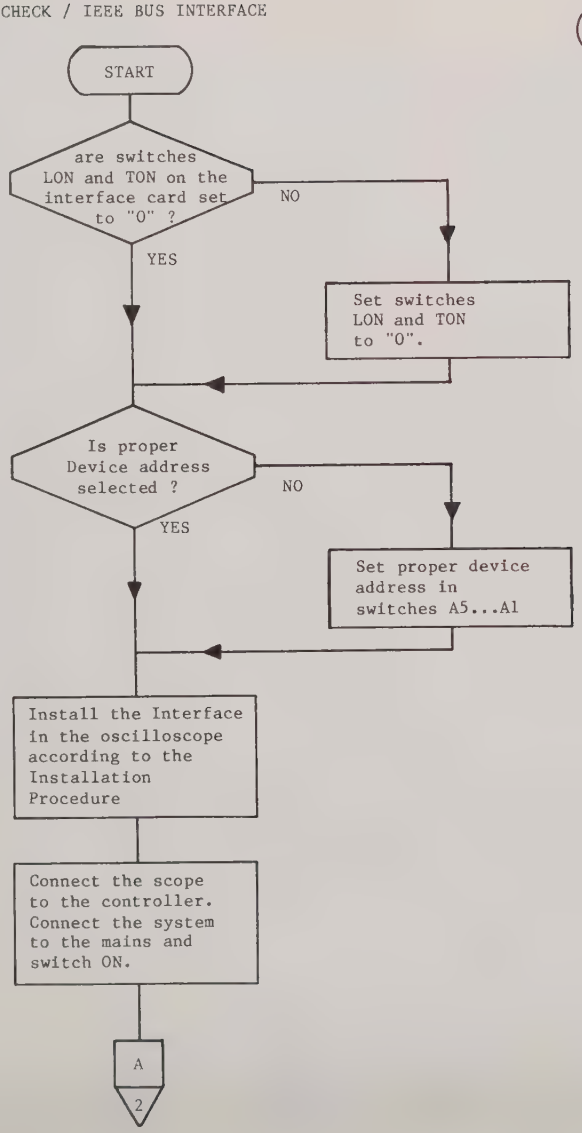
- HP-85 page 42

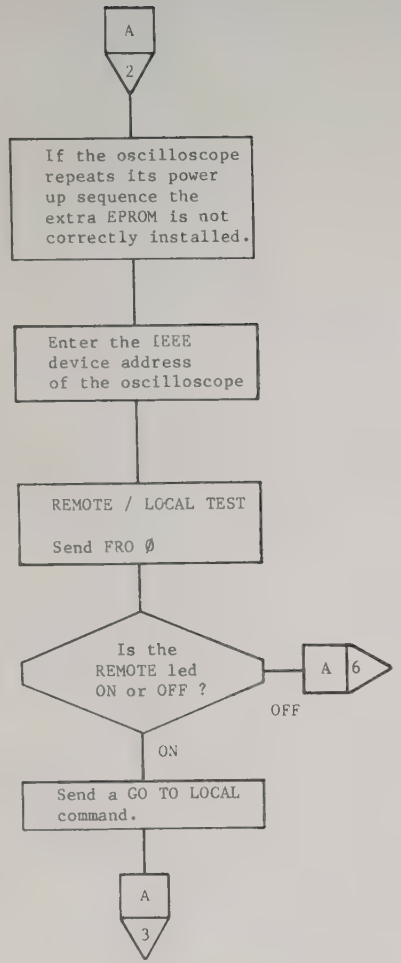
- CBM 4032 page 48

On each page a part of the flow-chart together with the corresponding literally program is given.

REMARK: For the PM 3315 it is necessary to apply a trigger signal during the test.

FUNCTIONAL CHECK / IEEE BUS INTERFACE

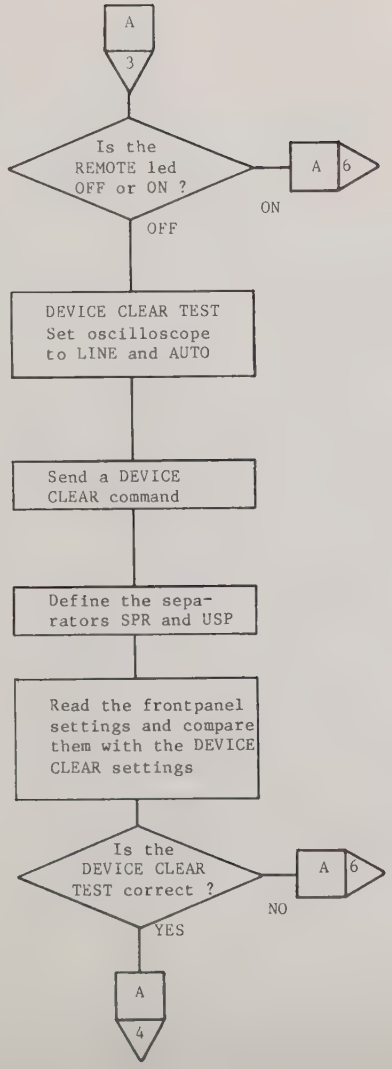

1
START
are switches LON and TON on the interface card set to "0" ?
NO
YES
Set switches LON and TON to "0".
Is proper Device address selected ?
NO
YES
Set proper device address in switches A5...A1
Install the Interface in the oscilloscope according to the Installation Procedure
Connect the scope to the controller. Connect the system to the mains and switch ON.
A
2




```
10 ! Programma 3310-1
20 ! Functional check PM 3310
   or PM 3311
30 P=0
40 CLEAR
50 CONTROL 7,16 ; 1,10
60 DISP @ DISP
70 DISP "Functional check for t
   he PM 3310 or PM 3311"
80 DISP
90 WAIT 500
100 CLEAR
110 DIM A$[80],B$[80],C$[80]
120 DISP @ DISP
130 DISP "Enter device address o
    f the"
140 DISP "oscilloscope to be tes
    ted ";
150 BEEP
160 INPUT A
170 IF A<1 OR A>31 OR A<>INT(ABS
    (A)) THEN 130
180 P=A+700
190 S=SPOLL(P)
200 CLEAR
210 BEEP
220 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue." @ PA
    USE
230 CLEAR
240 CLEAR P
250 LOCAL P
260 DISP "REMOTE LOCAL TEST"
270 OUTPUT P USING "K" ; "FRO 0"
280 DISP
290 DISP "Remote LED OFF or ON";
300 BEEP
310 INPUT A$
320 IF A$[2,2]="F" OR A$[2,2]="f
    " THEN 1400
330 LOCAL P
340 DISP
```

```
10 ! Programm PM3315

20 ! Functional check PM 3315.
30 P=0
40 CLEAR
50 CONTROL 7,16 ; 1,10
60 DISP @ DISP
70 DISP "Functional check for t
   he PM 3315"
80 DISP
90 WAIT 500
100 CLEAR
110 DIM A$[80],B$[80],C$[80]
120 DISP @ DISP
130 DISP "Enter device address o
    f the"
140 DISP "oscilloscope to be tes
    ted ";
150 BEEP
160 INPUT A
170 IF A<1 OR A>31 OR A<>INT(ABS
    (A)) THEN 130
180 P=A+700
190 S=SPOLL(P)
200 CLEAR
210 BEEP
220 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue." @ PA
    USE
230 CLEAR
240 CLEAR P
250 LOCAL P
260 DISP "REMOTE LOCAL TEST"
270 OUTPUT P USING "K" ; "FRO 0"
280 DISP
290 DISP "Remote LED OFF or ON";
300 BEEP
310 INPUT A$
320 IF A$[2,2]="F" OR A$[2,2]="f
    " THEN 1400
330 LOCAL P
340 DISP
```



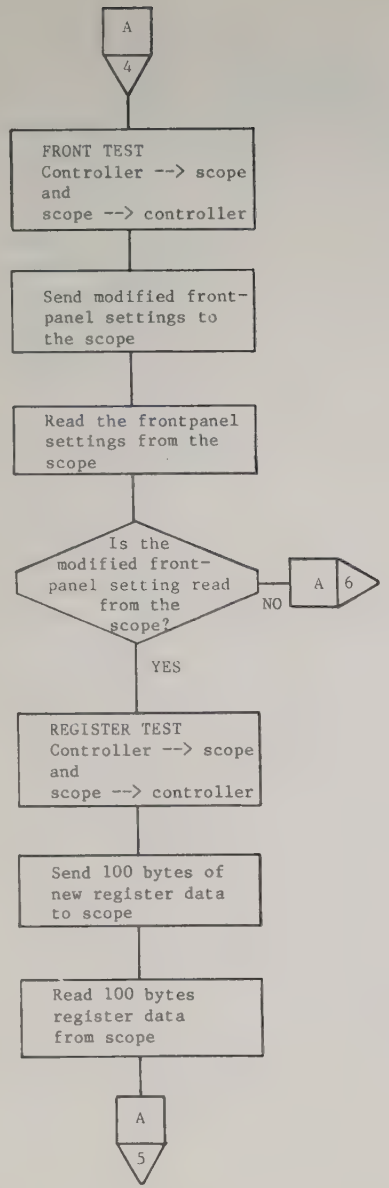
(3)

PM3310/11

```
350 DISP "Remote LED OFF or ON";
360 BEEP
370 INPUT A$
380 IF A$[2,2]="N" OR A$[2,2]="n
    " THEN 1400
390 DISP @ DISP
400 DISP "Remote/local test corr
    ect"
410 BEEP
420 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue." @ PA
    USE
430 CLEAR
440 DISP "DEVICE CLEAR TEST"
450 DISP
460 DISP "Set scope to LINE trig
    ger and"," - AUTO."
470 BEEP
480 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue." @ PA
    USE
490 CLEAR P
500 OUTPUT P USING "K" ; "SPR "
510 OUTPUT P USING "K" ; "USP /"
520 OUTPUT P USING "K" ; "FRO 0/
    HOR ?"
530 ENTER P ; A$
540 E=0 @ REM ERROR FLAG E=0 : N
    O ERROR
550 B$="HOR MTB/MOD REC/TIM .5E-
    03/RDY YES/TRD OFF"
560 IF B$<>A$ THEN E=1
570 OUTPUT P USING "K" ; "MSC ?"
580 ENTER P ; A$
590 C$="MSC AUX/DSP OFF/CLR OFF/
    WRT ON/SAV OFF/YVT ON/YVX OF
    F/YEX OFF/DOT OFF/PLT NO"
600 IF A$<>C$ THEN E=1
610 IF E=1 THEN 1400
620 DISP @ DISP
630 DISP "Device clear test corr
    ect"
640 BEEP
650 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue." @ PA
    USE
```

PM3315

```
350 DISP "Remote LED OFF or ON";
360 BEEP
370 INPUT A$
380 IF A$[2,2]="N" OR A$[2,2]="n
    " THEN 1400
390 DISP @ DISP
400 DISP "Remote/local test corr
    ect"
410 BEEP
420 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue." @ PA
    USE
430 CLEAR
440 DISP "DEVICE CLEAR TEST"
450 DISP
460 DISP "Set scope to LINE trig
    ger and"," - AUTO."
470 BEEP
480 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue." @ PA
    USE
490 CLEAR P
500 OUTPUT P USING "K" ; "SPR "
510 OUTPUT P USING "K" ; "USP /"
520 OUTPUT P USING "K" ; "FRO 0/
    HOR ?"
530 ENTER P ; A$
540 E=0 @ REM ERROR FLAG E=0 : N
    O ERROR
550 B$="HOR MTB/MOD REC/TIM .5E-
    03/TSO A/CPL AUT/LEV 0127/TS
    L POS/RDY YES/TRD OFF"
560 IF B$<>A$ THEN E=1
570 OUTPUT P USING "K" ; "MSC ?"
580 ENTER P ; A$
590 C$="MSC AUX/DSP OFF/CLR OFF/
    WRT ON/SAV OFF/YVT ON/YVX OF
    F/YEX OFF/DOT OFF/PLT NO"
600 IF A$<>C$ THEN E=1
610 IF E=1 THEN 1400
620 DISP @ DISP
630 DISP "Device clear test corr
    ect"
640 BEEP
650 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue " @ PA
    USE
```

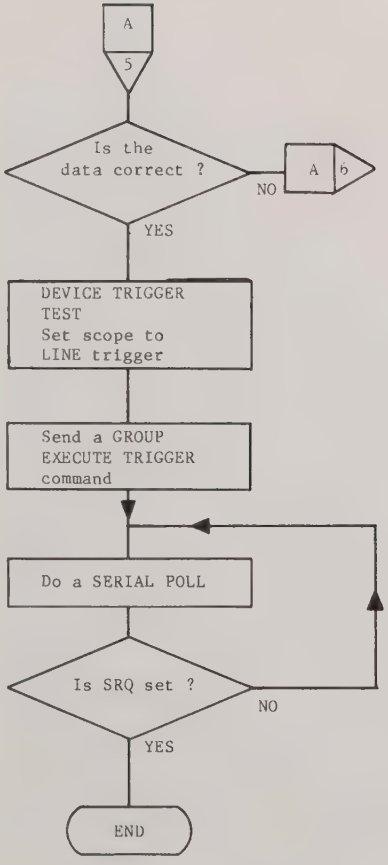


PM3310/11

```
660 CLEAR
670 DISP "FRONT TEST CONTROLLER
    --> SCOPE","AND SCOPE --> CO
    NTROLLER"
680 WAIT 500
690 OUTPUT P USING "K" ; "HOR MT
    B/TIM 5E-03/TIM ?"
700 ENTER P ; A$
710 IF A$<>"TIM 5E-03" THEN 1400
720 DISP
730 DISP "Front test correct"
740 BEEP
750 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue." @ PA
    USE
760 CLEAR
770 DISP "REGISTER TEST"
780 DISP "SCOPE <---> CONTROLLER
    "
790 DISP @ DISP
800 DISP "For this test, the com
    puter","generates a sinewave
     in the"
810 DISP "first four div. of the
     PM3310 or PM 3311 and","ver
    ifies proper datatransfer."
820 DISP
830 DISP "Be PATIENT, this takes
     a while!"
840 OUTPUT P USING "K" ; "WTD 30
    0"
850 OUTPUT P USING "K" ; "MSC AU
    X/LCK ON/REG 0/ VER A/FCN ON
    /BGN 0/END 255/CNT 1"
860 OUTPUT P USING "K" ; "DAT 12
    7"
870 FOR I=1 TO 100
880 X=127+INT(100*SIN(2*PI*I/50)
    )
890 OUTPUT P USING "K" ; X
900 NEXT I
910 E=0 @ REM ERROR FLAG SET TO
    0
920 WAIT 1000
930 CLEAR
940 DISP "  TEST REGISTER TRANSF
    ER"
950 DISP @ DISP
960 DISP "----------------------
    ---------"
970 DISP "-Datatransfer test pro
    ceeding -"
980 BEEP
990 DISP "----------------------
    ---------"
1000 DISP "Be PATIENT this takes
      a while"
1010 OUTPUT P USING "K" ; "BGN 0
     /END 100/CNT 1/DAT ?"
```

PM3315

```
660 CLEAR
670 DISP "FRONT TEST CONTROLLER
    --> SCOPE","AND SCOPE --> CO
    NTROLLER"
680 WAIT 500
690 OUTPUT P USING "K" ; "HOR MT
    B/TIM 5E-03/TIM ?"
700 ENTER P ; A$
710 IF A$<>"TIM 5E-03" THEN 1400
720 DISP
730 DISP "Front test correct"
740 BEEP
750 DISP @ DISP @ DISP "Press 'C
    ONT'- key to continue." @ PA
    USE
760 CLEAR
770 DISP "REGISTER TEST"
780 DISP "SCOPE <---> CONTROLLER
    "
790 DISP @ DISP
800 DISP "For this test, the com
    puter","generates a sinewave
     in the"
810 DISP "first  four div. of th
    e PM3315","and verifies prop
    er datatransfer."
820 DISP
830 DISP "Be PATIENT, this takes
     a while!"
840 OUTPUT P USING "K" ; "WTD 30
    0"
850 OUTPUT P USING "K" ; "MSC AU
    X/LCK ON/REG 0/ VER A/FCN ON
    /MSC AUX/BGN 0/END 255/CNT 1
    "
860 OUTPUT P USING "K" ; "DAT 12
    7"
870 FOR I=1 TO 100
880 X=127+INT(100*SIN(2*PI*I/50)
    )
890 OUTPUT P USING "K" , X
900 NEXT I
910 E=0 @ REM ERROR FLAG SET TO
    0
920 WAIT 1000
930 CLEAR
940 DISP "  TEST REGISTER TRANSF
    ER"
950 DISP @ DISP
960 DISP "----------------------
    ---------"
970 DISP "-Datatransfer test pro
    ceeding -"
980 BEEP
990 DISP "----------------------
    ---------"
1000 DISP "Be PATIENT this takes
      a while"
1010 OUTPUT P USING "K" ; "BGN 0
     /END 100/DAT ?"
```



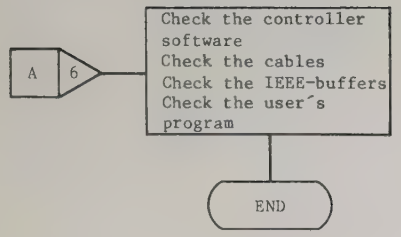
5

PM3310/11

```
1020 ENTER P ; E$
1030 FOR I=1 TO 100
1040 ENTER P ; A$
1050 IF VAL(A$)<>127+INT(100*SIN
     (2*PI*I/50)) THEN E=1
1060 NEXT I
1070 IF E=1 THEN 1400
1080 DISP @ DISP
1090 DISP "Register test correct
     "
1100 BEEP
1110 DISP @ DISP @ DISP "Press '
     CONT'- key to continue." @
     PAUSE
1120 CLEAR
1130 DISP "DEVICE TRIGGER TEST"
1140 LOCAL P
1150 FOR I=1 TO 100
1160 NEXT I @ REM DELAY
1170 TRIGGER P
1180 S=SPOLL(P)
1190 IF S<64 THEN 1180
1200 DISP
1210 DISP "Device trigger correc
     t"
1220 BEEP
1230 DISP @ DISP @ DISP "Press '
     CONT'- key to continue." @
     PAUSE
1240 CLEAR
1250 OUTPUT P USING "K" ; "IDT ?
     "
1260 ENTER P ; A$
1270 DISP " PM 3310 or PM 3311 T
     EST"
1280 DISP
1290 DISP "All tests completed."
1300 DISP
1310 DISP "PM 3310 or PM 3311  W
     ITH IEEE BUS INTER-","FACE
     IS WORKING CORRECTLY"
1320 DISP
1330 DISP "The unit tested is a"
1340 DISP A$
1350 BEEP @ BEEP @ BEEP
1360 DISP
1370 DISP "      To start a new t
     est","       press the RUN
     key."
1380 BEEP
1390 END
```

PM3315

```
1020 ENTER P ; E$
1030 FOR I=1 TO 100
1040 ENTER P ; A$
1050 IF VAL(A$)<>127+INT(100*SIN
     (2*PI*I/50)) THEN E=1
1060 NEXT I
1070 IF E=1 THEN 1400
1080 DISP @ DISP
1090 DISP "Register test correct
     "
1100 BEEP
1110 DISP @ DISP @ DISP "Press '
     CONT'- key to continue." @
     PAUSE
1120 CLEAR
1130 DISP "DEVICE TRIGGER TEST"
1140 LOCAL P
1150 FOR I=1 TO 100
1160 NEXT I @ REM DELAY
1170 TRIGGER P
1180 S=SPOLL(P)
1190 IF S<64 THEN 1180
1200 DISP
1210 DISP "Device trigger correc
     t"
1220 BEEP
1230 DISP @ DISP @ DISP "Press '
     CONT'- key to continue." @
     PAUSE
1240 CLEAR
1250 OUTPUT P USING "K" ; "IDT ?
     "
1260 ENTER P ; A$
1270 DISP "      PM 3315 TEST"
1280 DISP
1290 DISP "All tests completed."
1300 DISP
1310 DISP "PM 3315 WITH IEEE BUS
      INTER-","FACE IS WORKING C
     ORRECTLY"
1320 DISP
1330 DISP "The unit tested is a"
1340 DISP A$
1350 BEEP @ BEEP @ BEEP
1360 DISP
1370 DISP "      To start a new t
     est","       press the RUN
     key."
1380 BEEP
1390 END
```



(6)

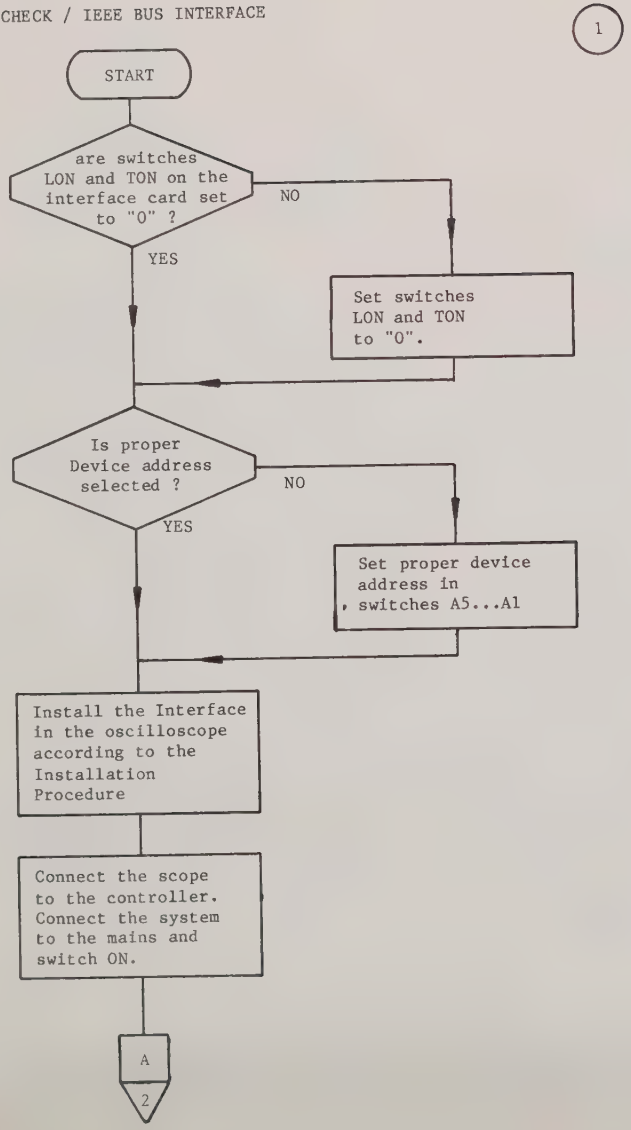
PM3310/11

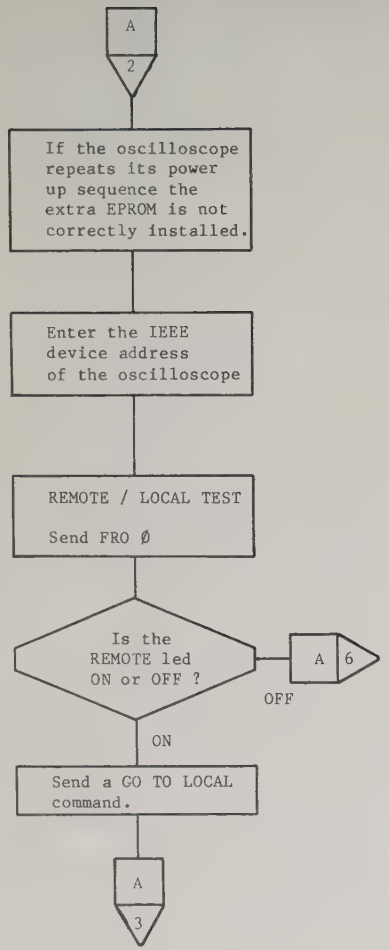
```
1400 DISP
1410 CLEAR
1420 DISP "CURRENT TEST FAILS!!"
1430 DISP "FIND ERROR AND RESTAR
     T","PROGRAM WITH 'RUN'-KEY"
1440 FOR I=1 TO 10
1450 BEEP
1460 NEXT I
1470 END
```

PM3315

```
1400 DISP
1410 CLEAR
1420 DISP "CURRENT TEST FAILS!!"
1430 DISP "FIND ERROR AND RESTAR
     T","PROGRAM WITH 'RUN'-KEY"
1440 FOR I=1 TO 10
1450 BEEP
1460 NEXT I
1470 END
```

FUNCTIONAL CHECK / IEEE BUS INTERFACE


1
START
are switches LON and TON on the interface card set to "0" ?
NO
YES
Set switches LON and TON to "0".
Is proper Device address selected ?
NO
YES
Set proper device address in switches A5...A1
Install the Interface in the oscilloscope according to the Installation Procedure
Connect the scope to the controller. Connect the system to the mains and switch ON.
A
2

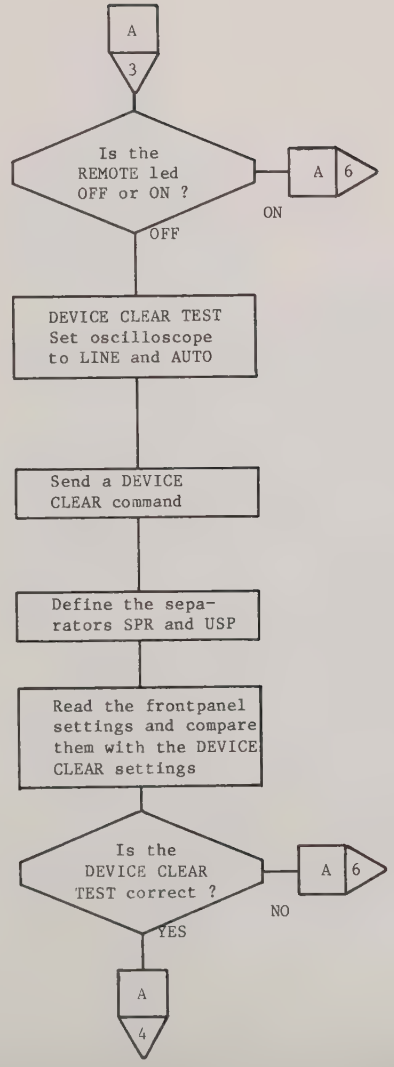

A
2
If the oscilloscope repeats its power up sequence the extra EPROM is not correctly installed.
Enter the IEEE device address of the oscilloscope
REMOTE / LOCAL TEST
Send FRO Ø
Is the REMOTE led ON or OFF ?
A 6
OFF
ON
Send a GO TO LOCAL command.
A
3

PM 3310/11

```
100 PRINT CHR$(147)
110 PRINT:PRINT:PRINT:PRINT
120 PRINT"FUNCTIONAL TEST FOR PM3310/11"
130 FOR I=1TO1000
140 NEXTI
150 PRINT CHR$(147)
160 DIM A$(80),B$(80),C$(80)
170 PRINT"THE SCOPE MUST BE AT ADRESS"
180 PRINT"8 !                         "
190 PRINT
200 PRINT"PUSH A KEY IF READY ."
210 A$=""
220 GETA$:IFA$="" THEN220
230 PRINT CHR$(147)
240 PRINT"REMOTE LOCAL TEST."
245 GOSUB 9330
250 PRINT
255 OPEN3,8
260 PRINT#3,"FRO 0"
265 CLOSE3
270 PRINT"IS REMOTE LED ON OR OFF"
280 PRINT"(TYPE ON  OR OFF)";
290 INPUT A$
300 IF MID$(A$,2,1)   ="F" THEN 8000
310 GOSUB 9180
320 PRINT
```

PM 3315

```
100 PRINT CHR$(147)
110 PRINT:PRINT:PRINT:PRINT
120 PRINT"FUNCTIONAL TEST FOR PM3315"
130 FOR I=1TO1000
140 NEXTI
150 PRINT CHR$(147)
160 DIM A$(80),B$(80),C$(80)
170 PRINT"THE SCOPE MUST BE AT ADRESS"
180 PRINT"8 !                         "
190 PRINT
200 PRINT"PUSH A KEY IF READY ."
210 A$=""
220 GETA$:IFA$="" THEN220
230 PRINT CHR$(147)
240 PRINT"REMOTE LOCAL TEST."
245 GOSUB 9330
250 PRINT
255 OPEN3,8
260 PRINT#3,"FRO 0"
265 CLOSE3
270 PRINT"IS REMOTE LED ON OR OFF"
280 PRINT"(TYPE ON  OR OFF)";
290 INPUT A$
300 IF MID$(A$,2,1)   ="F" THEN 8000
310 GOSUB 9180
320 PRINT
```



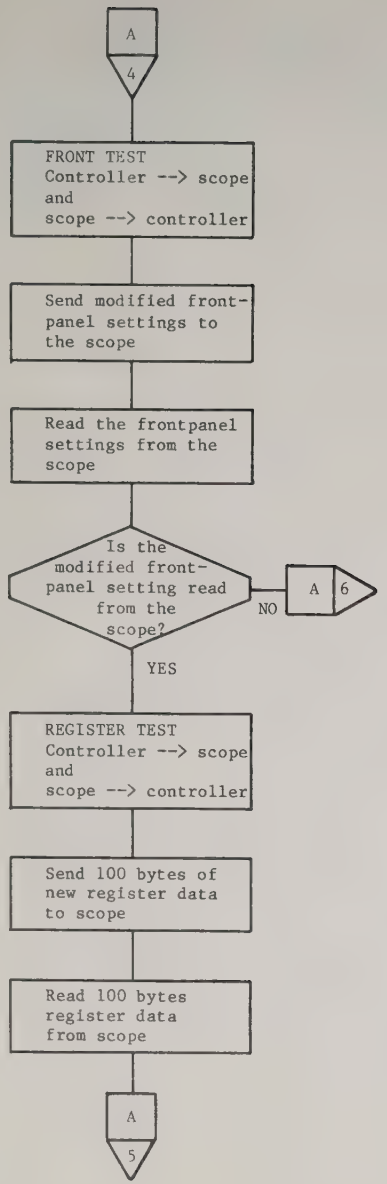
(3)

PM 3310/11

```
330 PRINT "IS REMOTE LED OFF OR ON"
340 PRINT"(TYPE OFF OR ON)";
350 INPUTA$
360 IF MID$(A$,2,1)  ="N" THEN 8000
370 PRINT
380 PRINT"REMOTE LOCAL TEST CORRECT!"
390 PRINT"PRESS ANY KEY TO CONTINUE."
400 A$=""
410 GET A$:IF A$="" THEN 410
420 PRINT CHR$(147)
430 PRINT"DEVICE CLEAR TEST"
440 PRINT
450 PRINT"SET SCOPE AT LINE TRIGGER!!"
460 PRINT"PRESS ANY KEY TO CONTINUE."
470 A$=""
480 GETA$:IF A$="" THEN 480
490 GOSUB 9280
500 OPEN3,8
510 PRINT#3,"SPR 013"
520 PRINT#3,"USP 047"
525 PRINT#3,"WTD 30"
530 PRINT#3,"FRD 0/HOR ?"
540 INPUT#3,A$
560 B$="HOR MTB/MOD REC/TIM .5E-03/RDY
    NO/TRD OFF"
565 E=0 : REM E=ERROR FLAG
570 IF B$<>A$ THEN 8000
580 IF B$<>A$ THEN E=1
590 PRINT#3,"MSC ?"
600 INPUT#3,A$
605 CLOSE3
610 C1$="MSC AUX/DSP OFF/CLR OFF/WRT ON/SAV
    OFF/YVT ON/YVX OFF/YEX OFF/DOT OFF"
615 C2$="/PLT NO"
617 C$=C1$+C2$
620 IF C$<>A$  THEN E=1
630 IF E=1 THEN 8000
635 PRINT
640 PRINT"DEVICE CLEAR TEST CORRECT."
650 PRINT"PRESS ANY KEY TO CONTINUE."
```

PM 3315

```
330 PRINT "IS REMOTE LED OFF OR ON"
340 PRINT"(TYPE OFF OR ON)";
350 INPUTA$
360 IF MID$(A$,2,1)  ="N" THEN 8000
370 PRINT
380 PRINT"REMOTE LOCAL TEST CORRECT!"
390 PRINT"PRESS ANY KEY TO CONTINUE."
400 A$=""
410 GET A$:IF A$="" THEN 410
420 PRINT CHR$(147)
430 PRINT"DEVICE CLEAR TEST"
440 PRINT
450 PRINT"SET SCOPE AT CHANNEL A TRIGGER
    AND CONNECT A SIGNAL TO CHANNEL A"
460 PRINT"PRESS ANY KEY TO CONTINUE."
470 A$=""
480 GETA$:IF A$="" THEN 480
490 GOSUB 9280
500 OPEN3,8
510 PRINT#3,"SPR 013"
520 PRINT#3,"USP 047"
525 PRINT#3,"WTD 30"
530 PRINT#3,"FRD 0/HOR ?"
540 INPUT#3,A$
560 B$="HOR MTB/MOD REC/TIM .5E-03/TSO
    A/CPL AUT/LEV 0127/TSL POS/RDY YES/"
562 B1$="TRD OFF"
565 E=0 : REM E=ERROR FLAG
570 IF B$+B1$<>A$ THEN 8000
580 IF B$+B1$<>A$ THEN E=1
590 PRINT#3,"MSC ?"
600 INPUT#3,A$
605 CLOSE3
610 C1$="MSC AUX/DSP OFF/CLR OFF/WRT ON/
    SAV OFF/YVT ON/YVX OFF/YEX OFF/DOT OFF"
615 C2$="/PLT NO"
617 C$=C1$+C2$
620 IF C$<>A$  THEN E=1
630 IF E=1 THEN 8000
635 PRINT
640 PRINT"DEVICE CLEAR TEST CORRECT."
650 PRINT"PRESS ANY KEY TO CONTINUE."
```



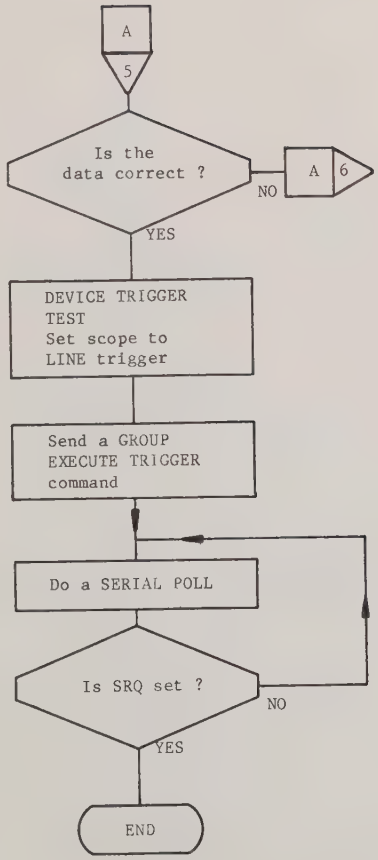
(4)

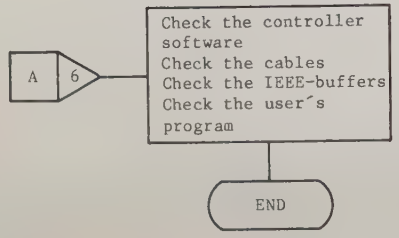
PM 3310/11

```
660 A$=""
670 GET A$ : IF A$="" THEN 670
680 PRINT  CHR$(147)
690 PRINT "FRONT TEST ( PM <=> CBM )"
700 PRINT
710 OPEN3,8
720 PRINT#3,"HOR MTB/TIM 5E-03/TIM ?"
730 INPUT#3,A$
735 CLOSE3
740 IF A$<>"TIM 5E-03" THEN 8000
750 PRINT"FRONT TEST CORRECT."
760 PRINT"PRESS ANY KEY TO CONTINUE."
770 A$=""
780 GET A$ : IF A$="" THEN 780
790 PRINT CHR$(147)
800 PRINT "REGISTER TEST ( PM <=> CBM )"
810 OPEN3,8
820 PRINT#3."MSC AUX/LCK ON/REG 0/VER
    A/FCN ON/BGN 0/END 100/CNT 1"
825 P=4*ATN(1)
827 PRINT#3,"DAT 127"
830 FOR I=0 TO 100
840 PRINT#3,127+INT(100*SIN(2*P*I/400))
850 NEXTI
860 E=0:REM ERRORFLAG SET TO 0
870 PRINT#3,"BGN 0/END 100/CNT 1/DAT ?"
875 INPUT#3,D$
880 FORI=0TO98
890 INPUT#3,A
900 IF A<>127+INT(100*SIN(2*P*I/400))THEN E=1
910 NEXT I
```

PM 3315

```
660 A$=""
670 GET A$ : IF A$="" THEN 670
680 PRINT  CHR$(147)
690 PRINT "FRONT TEST ( PM <=> CBM )"
700 PRINT
710 OPEN3,8
720 PRINT#3,"HOR MTB/TIM 5E-03/TIM ?"
730 INPUT#3,A$
735 CLOSE3
740 IF A$<>"TIM 5E-03" THEN 8000
750 PRINT"FRONT TEST CORRECT."
760 PRINT"PRESS ANY KEY TO CONTINUE."
770 A$=""
780 GET A$ : IF A$="" THEN 780
790 PRINT CHR$(147)
800 PRINT "REGISTER TEST ( PM <=> CBM )"
810 OPEN3,8
820 PRINT#3,"MSC AUX/LCK ON/REG 0/TER
    A/FCN ON/BGN 0/END 100/CNT 1"
825 P=4*ATN(1)
827 PRINT#3,"DAT 127"
830 FOR I=0 TO 100
840 PRINT#3,127+INT(100*SIN(2*P*I/400))
850 NEXTI
860 E=0:REM ERRORFLAG SET TO 0
870 PRINT#3,"BGN 0/END 100/CNT 1/DAT ?"
875 INPUT#3,D$
880 FORI=0TO98
890 INPUT#3,A
900 IF A<>127+INT(100*SIN(2*P*I/400))THEN E=1
910 NEXT I
```





(5)

PM 3310/11

```
920 IF E=1 THEN 8000
930 PRINT"REGISTER TEST CORRECT."
940 PRINT"PRESS ANY KEY TO CONTINUE."
950 A$=""
960 GETA$:IF A$="" THEN 960
970 PRINT CHR$(147)
980 PRINT"DEVICE TRIGGER TEST"
990 GOSUB 9180
1000 FOR I=1 TO 100
1010 REM WAIT LOOP
1020 NEXTI
1030 GOSUB 9230
1040 GOSUB 9330
1050 IF D<64 THEN 1040
1060 PRINT
1070 PRINT"DEVICE TRIGGER CORRECT."
1080 PRINT"PRESS ANY KEY TO CONTINUE."
1090 A$=""
1100 GETA$:IF A$="" THEN 1100
1110 PRINT CHR$(147)
1120 PRINT:PRINT:PRINT:PRINT
1130 PRINT"SCOPE WITH IEC-625 BUS INTERFACE"
1140 PRINT"IS WORKING CORRECT.                "
1150 END
```

```
8000 PRINT
8010 PRINT"CURRENT TEST FAILS!!"
8020 PRINT"FIND ERROR AND RESTART PROGRAMM."
8030 END
```

PM 3315

```
920 IF E=1 THEN 8000
930 PRINT"REGISTER TEST CORRECT."
940 PRINT"PRESS ANY KEY TO CONTINUE."
950 A$=""
960 GETA$:IF A$="" THEN 960
970 PRINT CHR$(147)
980 PRINT"DEVICE TRIGGER TEST"
990 GOSUB 9180
1000 FOR I=1 TO 100
1010 REM WAIT LOOP
1020 NEXTI
1030 GOSUB 9230
1040 GOSUB 9330
1050 IF D<64 THEN 1040
1060 PRINT
1070 PRINT"DEVICE TRIGGER CORRECT."
1080 PRINT"PRESS ANY KEY TO CONTINUE."
1090 A$=""
1100 GETA$:IF A$="" THEN 1100
1110 PRINT CHR$(147)
1120 PRINT:PRINT:PRINT:PRINT
1130 PRINT"SCOPE WITH IEC-625 BUS INTERFACE"
1140 PRINT"IS WORKING CORRECT.
1150 END
```

```
8000 PRINT
8010 PRINT"CURRENT TEST FAILS!!"
8020 PRINT"FIND EPROR AND RESTART PROGRAMM."
8030 END
```

6

PM 3310/11

```
9000 REM SEND TALK COMMAND
9010 REM SET DATA (72 IS TALK ADRRES
9020 REM PM3310/11
9030 C=72

9040 REM SET ATN "0" (SYNC. INTERRUPT)
9050 REM C=COMMAND TO BE<EXCECUTED
9060 POKE 59426,(255-C)
9070 A3=59456
9080 POKEA3,PEEK(A3)AND(255-4)
9090 REM DO TALKER HANDSHAKE
9100 GOSUB 9450
9110 REM SET ATN  1"
9120 POKEA3,PEEK(A3)OR4
9130 RETURN

9140 REM SEND UNTALK COMMAND
9150 REM SET UNTALK< DATA ( 95 )
9160 C=95
9168 GOTO 9040

9180 REM GO TO LOCAL
9190 C=40
9200 GOSUB 9040
9210 C=1
9220 GOTO 9040

9230 REM DEVICE TRIGGER
9240 C=40
9250 GOSUB 9040
9260 C=8
9270 GOTO 9040

9280 REM DEVICE CLEAR
9290 C=40
9300 GOSUB 9040
9310 C=4
9320 GOTO 9040

9330 REM SERIAL POLL
9340 C=63 :REM UNLISTEN BUS
9350 GOSUB 9040
9360 C=24:REM SERIAL POLL ENABLE
9370 GOSUB 9040
9380 C=72:REM ADRESS TALKER
9390 GOSUB 9040
9400 GOSUB 9640:REM INPUT STATUS IN D
9410 GOSUB 9140:REM UNTALK
9420 C=25    :REMREM DISABLE SERIAL POLL
9430 GOSUB 9040
9440 RETURN
```

PM 3315

```
9000 REM SEND TALK COMMAND
9010 REM SET DATA (72 IS TALK ADRRES
9020 REM PM3315
9030 C=72

9040 REM SET ATN "0" (SYNC. INTERRUPT)
9050 REM C=COMMAND TO BE<EXCECUTED
9060 POKE 59426,(255-C)
9070 A3=59456
9080 POKEA3,PEEK(A3)AND(255-4)
9090 REM DO TALKER HANDSHAKE
9100 GOSUB 9450
9110 REM SET ATN "1"
9120 POKEA3,PEEK(A3)OR4
9130 RETURN

9140 REM SEND UNTALK COMMAND
9150 REM SET UNTALK< DATA ( 95 )
9160 C=95
9168 GOTO 9040

9180 REM GO TO LOCAL
9190 C=40
9200 GOSUB 9040
9210 C=1
9220 GOTO 9040

9230 REM DEVICE TRIGGER
9240 C=40
9250 GOSUB 9040
9260 C=8
9270 GOTO 9040

9280 REM DEVICE CLEAR
9290 C=40
9300 GOSUB 9040
9310 C=4
9320 GOTO 9040

9330 REM SERIAL POLL
9340 C=63 :REM UNLISTEN BUS
9350 GOSUB 9040
9360 C=24:REM SERIAL POLL ENABLE
9370 GOSUB 9040
9380 C=72:REM ADRESS TALKER
9390 GOSUB 9040
9400 GOSUB 9640:REM INPUT STATUS IN D
9410 GOSUB 9140:REM UNTALK
9420 C=25    :REMREM DISABLE SERIAL POLL
9430 GOSUB 9040
9440 RETURN
```

PM 3310/11

(7)

```
9450 REM TALKER HANDSHAKE
9460 A3=59456:A4=59425:A2=59427
9470 A1=59426
9480 REM ENABLE NDAC AND NRFD
9490 POKEA4,PEEK(A4)OR8
9500 POKEA3,PEEK(A3)OR2
9510 REM WAIT UNTIL NRFD "1"
9520 T=PEEK(A3)AND64:IFT=0THEN9520
9530 REM SET DAV "0"
9540 POKEA2,PEEK(A2)AND(255-8)
9550 REM WAIT UNTIL NDAC "1"
9560 T=PEEK(A3)AND1:IFT=0THEN 9560
9570 REM SET DAV "1"
9580 POKEA2,PEEK(A2)OR8
9590 REM REMOVE DATA
9600 POKEA1,255
9610 REM REMOVE NDAC
9620 POKEA4,PEEK(A4)AND(255-8)
9630 RETURN
```

```
9640 REM LISTENER HANDSHAKE
9650 A1=59426:A2=59427:A3=59456
9660 A4=59425
9670 REM ENABLE NRFD
9680 POKEA3,PEEK(A3)OR2
9690 REM WAIT FOR DAV "0"
9700 T=PEEK(A3)AND128:IFT=1THEN9700
9710 REM SET NRFD "0"
9720 POKEA3,PEEK(A3)AND(255-2)
9730 REM WAIT FOR NRFD "0"
9740 T=PEEK(A3)AND64:IFT=1THEN9740
9750 REM LOAD DATA IN D
9760 D=PEEK(59424)
9770 REM SET NDAC "1"
9780 POKEA4,PEEK(A4)OR8
9790 REM WAIT FOR DAV "1"
9800 T=PEEK(A3)AND128:IFT=0THEN 9800
9810 REM NDAC "0"
9820 POKEA4,PEEK(A4)AND(255-8)
9830 RETURN
```

PM 3315

```
9450 REM TALKER HANDSHAKE
9460 A3=59456:A4=59425:A2=59427
9470 A1=59426
9480 REM ENABLE NDAC AND NRFD
9490 POKEA4,PEEK(A4)OR8
9500 POKEA3,PEEK(A3)OR2
9510 REM WAIT UNTIL NRFD "1"
9520 T=PEEK(A3)AND64:IFT=0THEN9520
9530 REM SET DAV "0"
9540 POKEA2,PEEK(A2)AND(255-8)
9550 REM WAIT UNTIL NDAC "1"
9560 T=PEEK(A3)AND1:IFT=0THEN 9560
9570 REM SET DAV "1"
9580 POKEA2,PEEK(A2)OR8
9590 REM REMOVE DATA
9600 POKEA1,255
9610 REM REMOVE NDAC
9620 POKEA4,PEEK(A4)AND(255-8)
9630 RETURN
```

```
9640 REM LISTENER HANDSHAKE
9650 A1=59426:A2=59427:A3=59456
9660 A4=59425
9670 REM ENABLE NRFD
9680 POKEA3,PEEK(A3)OR2
9690 REM WAIT FOR DAV "0"
9700 T=PEEK(A3)AND128:IFT=1THEN9700
9710 REM SET NRFD "0"
9720 POKEA3,PEEK(A3)AND(255-2)
9730 REM WAIT FOR NRFD "0"
9740 T=PEEK(A3)/64:IFT=1THEN9740
9750 REM LOAD DATA IN D
9760 D=PEEK(59424)
9770 REM SET NDAC "1"
9780 POKEA4,PEEK(A4)OR8
9790 REM WAIT FOR DAV "1"
9800 T=PEEK(A3)AND128:IFT=0THEN 9800
9810 REM NDAC "0"
9820 POKEA4,PEEK(A4)AND(255-8)
9830 RETURN
```

SURVEY OF HEADER-BODY COMBINATIONS OF PM 3325-10

HEADER		BODY					
SPR		0...31					
USP		0...126					
WTD		0...9999					
IDT		?					
——FRO		0	OFF				
├—REG		0	1	2	3	OFF	
F/R	VER	A	B	ADD*	SUB*		
F/R	FCN	ON	OFF				
F/R	CPL	AC	DC	ZERO			
F	PRO	?					
F/R	INV	ON	OFF				(B only)
F/R	ATT	10E-03	20E-03	50E-03	.1E+00	.2E+00	.5E+00
		1E+00	2E+00	5E+00	10E+00	20E+00	50E+00
		.1E+03	.2E+03	.5E+03			
R	CAL	ON	OFF				
F/R	CAL	?					
F/R	HOR	MTB					
F/R	MOD	REC	SNG	MLP	ROLL		
F/R	TIM	5E-09	10E-09	20E-09	50E-09	.1E-06	.2E-06
		.5E-06	1E-06	2E-06	5E-06	10E-06	20E-06
		50E-06	.1E-03	.2E-03	.5E-03	1E-03	2E-03
		5E-03	10E-03	20E-03	50E-03	.1E+00	.2E+00
		.5E+00	1E+00	2E+00	5E+00	10E+00	20E+00
		30E+00	60E+00	.12E+03	.36E+03	.9E+03	1.8E+03
		3.6E+03					
F	TSO	A	B	EXT	LINE		
F	CPL	AC	DC	AUT	TVF		
F	LEV	0...255					
F	TSL	POS	NEG				
F	RDY	?					
F/R	TRD	-9...0	0...9999	OFF			
F/R	MSC	AUX					
R	DSP	ON	OFF				
F	DSP	ALL	OFF				
F	CLR	ON	OFF				
F	WRT	ON	OFF				
F	LCK	ON	OFF				
F	SAV	1	2	3	OFF		MULT.BODY
F	YVT	ON	OFF				
F	YVX	ON	OFF				
F	YEX	ON	OFF				
F	DOT	ON	OFF				
R	INV	ON	OFF				
F/R	PLT	YES	NO				
R	DAT	A	B	ALL			
R	BGN	0...255					
R	END	0...255					
R	CNT	1...255					
R	DAT	0...255	?				MULT.BODY

Short explanation:
F = FRO 0; R = REG (BODY).
When a character is preceeding a command, first programm the command belonging to that character.
*: Only in combination with FCN ON or OFF.

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